PARENTAL BELIEFS ON THE EARLY IDENTIFICATION OF FUTURE OVERWEIGHT RISK AND THE DEVELOPMENT OF A SCALE TO ASSESS PARENTAL ENGAGEMENT IN PREVENTION

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Abstract

Parents play a crucial role in the prevention of child obesity but to date, little is understood regarding their beliefs about overweight and obesity in early childhood and how these may influence receptiveness to engage in preventative interventions. The primary aim of this research project was to identify factors influencing engagement and to develop a new psychometric scale to measure parental engagement in obesity prevention. To address the research aims, a two-phase mixed methods design was employed. In study one, 20 parents of infants under one were individually interviewed, using an inductive and interpretive qualitative approach. Thematic analysis resulted in three themes: 1) the identification of infant overweight and future risk, 2) the consequences of infant overweight status, and 3) parental attributions of causality, responsibility, and control. Study one findings, along with existing research and theory, informed the development of salient constructs for inclusion within a new scale: The Parental Engagement in Obesity Prevention (PEOP) scale. Exploratory factor analysis was performed within a sample of 282 mothers and a stable four-factor solution was identified. Confirmatory factor analysis in a new sample of 446 mothers confirmed the structure and demonstrated acceptable levels of reliability. The PEOP has 19-items and measures four conceptually unique factors influencing parental engagement: fear of judgement about infant weight; perceived consequences of infant overweight; maternal drive to feed; and self-efficacy in identifying infant overweight. The absolute scores from the four subscales indicate that mothers within this study sample did not fear judgement about their infants' weight and felt confident in recognising if their own infant was or was becoming overweight. However, potential negative influences on engagement included a strong drive to feed their infant and a poor perception of the health consequences and implications of infant overweight. The study provides new insight and a valid and reliable measure of parental engagement. Use of the scale in practice will support identification of parents less likely to engage in prevention so that perceived barriers can be minimised.

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Chapter One
Introduction

The escalating prevalence of childhood overweight and obesity continues to be a global public health concern. Recent years have seen growing evidence of early life risk factors that predispose a child to future risk of developing childhood overweight and obesity (Woo Baidal, et al. 2016). Knowledge of these risks has led to the advent of obesity risk prediction tools to identify risk during infancy (Canfell, et al. 2018). These advances, coupled with evidence to support the efficacy of early infant feeding interventions (Redsell, et al. 2015; Matvienko-Sikar, et al. 2018), present promising opportunities for prevention.

Parents are key stakeholders in the prevention of childhood obesity and play a crucial role in positively influencing early feeding behaviours that promote a healthy weight. Despite the critical importance of their involvement, little is currently understood about how parents perceive infant overweight, their role in prevention and how in turn, these beliefs may influence receptiveness and engagement in early interventions. Research on parental engagement within healthcare, a relatively new area of research, highlights the importance of parental involvement for the success of early preventative interventions (Heinicke, et al. 2000). Existing literature on parental engagement with obesity is primarily focused upon attendance of child weight management programmes (Skelton and Beech 2011). To date, there is a scarcity of evidence relating to obesity prevention, particularly during infancy (Love, et al. 2018) and predictors of parental engagement in obesity prevention remain unclear. This study addresses these gaps in research by identifying the salient factors that may influence parental engagement in the prevention of childhood obesity and developing a new scale to measure these factors. The new scale is informed by the Health Belief Model (HMB) (Becker 1974; Rosenstock, Strecher and Becker, 1988) and qualitative research of parental perceptions of their infants. This thesis offers valuable insight and a new scale for use in practice to support health professionals. Use of the scale will help to identify those parents who may perceive or experience barriers to becoming engaged, thereby allowing them to be targeted for support to minimise or omit such barriers to engagement and subsequent behaviour change.

In order to orientate the reader, the structure of the thesis and the contents of its chapters are outlined. Following this introduction chapter, Chapter two reviews the

existing literature. This includes evidence of the early life risk factors for future overweight and obesity, obesity risk tools and interventions to prevent obesity during infancy. The concept of engagement is then introduced and parental engagement in childhood obesity discussed. This is followed by a review of the existing literature that focuses on perceptions of parents and health care professional regarding infant overweight and later risk of obesity. Chapter two concludes by presenting the aim and objectives of the research project. Chapter three discusses models and theories of parental engagement before providing a rationale for the choice of the Health Belief Model as the most suitable for this project. The second part of Chapter three discusses the philosophical assumptions of the research and mixed methods approach that is adopted. Chapter four addresses study one, the initial qualitative phase of this two-part mixed methods design. The chapter outlines the aims of study one and presents the findings, identifying three themes: 1) The identification of infant overweight and future risk, 2) the consequences of infant overweight status, and 3) parental attributions of causality, responsibility, and control. The two or three corresponding subthemes are also discussed. Chapter five describes the process of choosing and presents the rationale for, the constructs included within the new scale, the Parental Engagement in Obesity Prevention (PEOP) scale. Six constructs, informed by qualitative research themes, existing literature and the health belief model, are identified; 1) Self-efficacy to prevent overfeeding/influence weight through feeding, 2) guilt and self-blame in relation to infant weight and guilt associated with reducing milk/food, 3) self-efficacy in identifying infant overweight, 4) fear of judgement, 5) perception of health and other related risks of obesity and 6) perception of causal attributions for infant weight (locus of causality). They were then utilised to inform the development of salient constructs for inclusion within the new scale. The second part of Chapter five provides details of the steps taken to develop the scale, the development of 95 items to capture the constructs and their content validity. Chapter six is concerned with study two in which a measure of parental engagement in obesity prevention was constructed using factor analysis with mothers of infants aged one or under. Exploratory factor analysis was performed with a sample of 282 mothers, providing the factor structure for the pool of 95 items. A total of four stable factors were identified, which were largely representative of those that had been initially proposed. To confirm the factor structure, confirmatory factor analysis was undertaken with a new sample of 446 mothers. The analysis confirmed a good model fit and resulted in a 19-item scale with four subscales: maternal fear of judgement about infant overweight; maternal awareness of the consequences and tracking of infant overweight; maternal drive to feed; and maternal self-efficacy to identify infant overweight. The latter part of the chapter presents the absolute scale and subscale scores within a combined sample and the statistical analyses performed to identify any

difference in responses between groups of mothers. This analysis identified mothers within the sample as not fearing judgement about their infants' weight. They were also confident about recognising if their own infant was or was becoming overweight. However, they had a strong drive to feed their infant and did not perceive any health consequences to infant overweight or recognise the tracking of infant overweight into later childhood. Several statistically significant differences were also found between some mother and infant characteristics and responses to certain subscales. The thesis concludes with Chapter seven which presents and discusses the research's key findings and their relevance to existing literature. This is followed by suggestions for the use of the Parental Engagement in Obesity Prevention (PEOP) scale within practice and recommendations for future research.

Chapter Two
Literature Review

2.1 Introduction

This chapter provides an overview of the literature relevant to the prevention of childhood overweight and obesity during infancy. The chapter begins by offering the definitions, prevalence and consequences of childhood obesity and presents an argument for early preventative intervention. This is followed by a narrative review of evidence regarding early life risk factors of childhood overweight and obesity and the development of risk prediction tools and their application. The identification of infants at increased risk provides opportunity for early and targeted intervention. The first part ends with a review of promising evidence from existing interventions. The second part of the chapter discusses the role of parents and introduces literature on parental engagement and parental perceptions of infant and early childhood overweight. In particular, it presents the extant literature on parental perceptions of risk communication and intervention during infancy and highlights the barriers to intervention. The chapter concludes with a summary of how this research project set about meeting the identified research gaps and presents the case for a new scale to assess barriers to parental engagement in the early prevention of childhood obesity.

2.2 Defining childhood overweight and obesity

Obesity is defined as “a condition of excess body fat to the extent that it may have an adverse effect on health” (SACN and RCPCH 2012). The definition suggests that Body Mass Index (BMI) threshold centiles at which obesity in children is categorised, is based upon evidence of a link with health risk. However, unlike for adults, the exact point at which the short and long-term health risks of childhood overweight and obesity present themselves is largely unknown (SACN and RCPCH 2012). The lack of evidence linking the health implications to a specific BMI threshold has resulted in several published reference populations and thresholds to which childhood BMI can be compared. Commonly used charts are the UK 1990 (UK90), International Obesity Task Force (IOTF), Centers for Disease Control (CDC) and World Health Organization (WHO) charts (Dinsdale and Ridler, 2011). There is currently no internationally agreed definition for childhood obesity, which presents difficulties when comparing prevalence between countries. Worldwide, the prevalence of childhood overweight and obesity varies

considerably depending on the criteria used to define obesity (Wang and Lobstein, 2006).

In April 2006, international growth standards for children aged 0–59 months were published, to provide a single international standard that represents the best description of physiological growth. These were for all children from birth to five years of age and established the breastfed infant as the normative model for growth and development (WHO, 2006). By 2011, these had been adopted by 125 countries but were not fully adopted in the UK. Instead, the Department of Health recommended the use of new charts, known as UK-WHO charts to measure growth in children under four years old. The new UK-WHO charts were developed by the Royal College of Paediatrics and Child Health (RCPCH), and combined WHO data with recalculated British 1990 birth data (UK90) (SACN 2008). (The new UK-WHO charts replaced those based upon the growth of babies that had been predominantly formula rather than breastfed. From four years of age, the UK 1990 growth reference charts are used (Wright, et al. 2002)).

During the first two years of life, anthropometric indicators such as weight-for age (WFA), (adopted almost universally), length/height-for-age (LHFA) and weight-for-length/height (WFLH) are used rather than BMI. This is because prior to two years of age, it is considered difficult to measure a child's height with any reasonable accuracy. After the age of two years old, BMI is the most frequently used measure of overweight and obesity for children within the UK. BMI is calculated as it would be for an adult and then, due to changing child growth patterns, is compared with a reference population by age and sex. Overweight and obesity at a certain BMI threshold is defined in terms of a specific z-score, or centile, on a child growth reference. The age of the child determines which growth standard and threshold is recommended for use in order to categorise childhood overweight and obesity.

2.3 Prevalence and consequences of childhood obesity

The escalating prevalence of overweight and obesity in children is a growing global public health crisis and is no longer an issue seen only within high-income countries (WHO, 2016). The last forty years have seen a tenfold increase in the number of obese children and adolescents, rising from 11 million to 124 million in 2016. In addition, a further 216 million children are overweight (Abarca-Gomez, et al. 2017).

Childhood obesity has significant physical and psychological consequences (De Niet and Naiman, 2011). The financial costs of childhood obesity and its related conditions

are estimated to cost the NHS £6.1 billion per year, with the total expense to society projected at £27 billion per year (PHE, 2017). For some time, it has been known that children with obesity are predisposed to an increased risk of cardiovascular morbidity and mortality in adulthood due to metabolic disturbances related to central visceral adiposity (Abrams and Levitt Katz, 2011; Reilly and Kelly, 2011). However, there is now evidence that cardiovascular damage is now also occurring within obese children (Cote, et al. 2013).

There is also a high prevalence of fatty liver disease amongst obese children which has the associated complications of steatohepatitis (non-alcoholic liver disease) and cirrhosis. Other physical health problems include hyperandrogenism, an over production of androgens causing acne and excessive facial hair production, sleep disturbances and orthopaedic complications (Abrams and Levitt Katz, 2011). Obese children are also at higher risk of psychological problems including depression, low self-esteem and a poorer quality of life (De Niet and Naiman, 2011) as well as body dissatisfaction (Harriger and Thompson, 2012).

In 2016, approximately 41 million children (6% of the worldwide population) under the age of 5 years were overweight and there has been little progress to stem prevalence rates in more than 15 years (UNICEF/WHO/World Bank Group, 2017). In the UK, prevalence data is currently only available for children age 4-5 years old when they are starting school. Yet by this age, already over a fifth of children (22.6%) are overweight or obese (NHS Digital 2019); children from low-income households and black and minority ethnic families are disproportionally affected (NHS Digital 2019).

Data on the prevalence of overweight and obesity amongst infants and preschool children is limited and difficult to interpret; however, prevalence and trend data from the European Union suggests that countries in the Mediterranean and British Isles have higher rates than middle, northern and Eastern Europe (Cattaneo, et al. 2010). Data for children between 24-59 months old is only available for 18 of the 27 EU countries and only four of those, excluding the UK, have data for children under the age of two. Of the four countries (Spain, Italy, Romania and The Czech Republic), BMI-for-age (WHO standard) was highest amongst infants living in Spain (Cattaneo, et al. 2010).

The scarcity of prevalence data for children under two is explained by both a lack of existing guidelines for identifying overweight or obesity in pre-school children and infants (Kuczmarski, et al. 2002) and lack of routine clinical assessment or epidemiological surveillance in preschool and infants (Cattaneo, et al. 2010). WHO now

recognises infancy as a key time for prevention and has recommended that all frontline healthcare workers should actively identify and manage pre-school children who are overweight or obese (WHO, 2016). Measuring the height and weight of infants and children under five presenting to primary care will allow weight-for-height to be determined and at-risk children to be identified and enable early targeted intervention.

Evidence of the how overweight and obesity can track into later life is seen not only between child and adulthood (Singh, et al. 2008) but also between pre-school age and later childhood (Nader, et al. 2006; Gardner, et al. 2009). Overweight at age five is also predictive of weight at age nine, when correlations with a metabolic score based on the metabolic syndrome was at its strongest (Gardner, et al. 2009). These findings have significant implications for the health risks of excess weight in early childhood and highlight the importance of early intervention to prevent excess weight gain in children under five, by which time almost twenty percent of children are already overweight or obese (NHS Digital 2019).

2.4 Early Life Risk Factors for Childhood Overweight and Obesity

The identification of risk factors that predispose a person to developing overweight or obesity has become a key public health strategy. The significance of early life and intrauterine factors that may predispose a child to the future risk of becoming overweight or obese were first identified through epidemiological studies, some over a decade ago (Reilly, et al. 2005; Hawkins, Cole and Law, 2009; Fairley, et al. 2015).

An early study by Reilly and colleagues (2005) used data from the Avon Longitudinal Study of Parents and Children (ALSPAC), a longitudinal UK birth cohort study of almost 14,000 children exploring the determinants of health and disease during childhood (Golding, 2004). A random subsample of children between four months and five years of age was used to determine obesity risk at age seven (BMI on or >95th centile UK 1990 population). A possible 25 risk factors occurring before the age of three years old were investigated, 21 within the entire cohort of 5493 and four growth related factors within a smaller subsample of 909 children. Eight of the 25 were found to be associated with an increased risk of obesity at age seven years old. These included, pre-pregnancy parental obesity, increased birth weight, maternal smoking in pregnancy, more than eight hours per week watching television (age three years), less than twelve hours sleep duration at 30 months old and early BMI or adiposity rebound, or early change in BMI up

to 60 months old. Early BMI or adiposity rebound is the point of maximal leanness or minimal BMI occurring between three and seven years old. This happens before a gradual increase through adolescence and most of adulthood (Rolland-Cachera, et al. 1984).

The second study (Hawkins, Cole and Law, 2009) utilised data from the UK Millennium Cohort Study (MCS) (Dex and Joshi, 2005) to assess risk factors for overweight and obesity in three year old children. The MCS collected observational data on children born between September 2000 and January 2002 living in England, Wales, Scotland or Northern Ireland who had parents in receipt of child benefit. The study had an original sample of 18,819 children (Dex and Joshi, 2005) and complete data were available for 13,188 children. The outcome measure was childhood overweight and obesity defined by the International Obesity Task Force cut offs for BMI (Cole, et al. 2000). A total of 26 risk factors based upon previous research findings (Hawkins and Law 2006; Hawkins, Cole and Law, 2008) were examined, including family, community, area level and individual factors. Unadjusted results showed that ten of the original risk factors have a positive association with overweight at age three, with 18% of children overweight and a further 5% obese. However, in the fully adjusted model, only nine of the factors remained statistically significant ($p<0.05$). These were primarily individual or family level factors. Significant factors included parental overweight (BMI >25kg/m^2), black ethnicity (compared to white), introduction of solid foods before four months, lone motherhood, smoking during pregnancy, maternal pre-pregnancy overweight and maternal employment of over twenty-one hours per week.

Fairley and colleagues (2015) investigated risk factors and their association with BMI z-score and childhood overweight at three years old and ethnicity (Fairley, et al. 2015). Overweight was defined as BMI z-score greater or equal to the 85th centile (Dinsdale and Ridler, 2011) The study used data from a sub-study of the Born in Bradford Birth Cohort study (Wright, et al. 2013), a multi-ethnic longitudinal cohort of 12,453 mothers recruited during pregnancy between 2007 and 2010. To examine the aetiology of obesity, a sub-sample (1735) were recruited between August 2008 and March 2009. The sub-sample were then followed up every six months until two years old and then finally, at age three years (Bryant, et al. 2013). Results showed that at age three, 30% of the children were overweight, with a higher prevalence amongst white British compared to Pakistani children (Fairley, et al. 2015). In the fully adjusted model six of the predictors were significantly associated with higher BMI z-scores; maternal smoking, maternal overweight and obesity; breastfed between one day and one month (compared to never breastfed) indulgent parental feeding style; lower parental warmth scores;

higher parental hostility scores. There was no evidence to suggest that the relationship between risk factors and BMI z-score differed by ethnicity.

Understanding the early life risk factors for later overweight and obesity is a growing area of research and prospective observational findings have informed two systematic reviews and a meta-analysis (Weng, et al. 2012 Woo Baidal, et al. 2016). The earliest was a review and meta-analysis of risk factors for future overweight, identifiable prenatally and during the first year of a child's life (Weng, et al. 2012). Childhood overweight and obesity was defined by: the International Obesity Task Force (IOTF) as corresponding to an adult BMI ≥25 or ≥30 kg/m2 (Cole, et al. 2000); the Centers for Disease Control and Prevention (CDC, 2000) as a BMI ≥85th or ≥95th percentile; and the UK 1990 reference as a BMI ≥95th or ≥98th percentile (Cole, 2000). The review included 30 prospective studies published between 1990 and May 2011. For inclusion within the review, studies needed a minimum of two years of data from birth to allow enough time for the development of overweight or obesity to be identified. The age of the children within the studies ranged from two to 14 years old with a median age of six years at follow up. Eighteen risk factors were identified from the existing studies, including maternal age and education, infant temperament, gestational weight gain and rapid weight gain (Weng, et al. 2012). The results identified four risk factors with significant strong associations to later overweight: maternal pre-pregnancy overweight; high infant birth weight; early infant rapid weight gain; and smoking in pregnancy. There was some evidence to suggest that ever being breastfed in the first year of life had a moderate protective on development of later overweight. Introduction of solid foods prior to four months of age was also associated with later overweight. The influence of duration of breastfeeding, socioeconomic status at birth, parity and marital status, was conflicting. In addition, type of delivery, maternal postpartum weight loss, gestational weight gain and a fussy infant temperament were inconclusive. This was thought to be due to the limited number of studies on these factors at the time of the review.

The second systematic review (Woo Baidal, et al. 2016) examined modifiable risk factors present within the 'first 1000 days', the period between conception and aged two years old and confirmed many of the findings of the earlier review (Weng, et al. 2012). The review included 282 prospective studies published between January 1980 and December 2014, demonstrating the growth of published research in this area. The outcome measure was overweight or obesity (BMI ≥85th percentile for age and sex) and was collected for all children between six months and 18 years old, so included data from younger infants than Weng and colleagues (Weng, et al. 2012). Researchers examined exposure to risk factors from conception through to two years of age.

Between conception and birth, a possible 18 risk factors were identified from the prospective studies: five were biological, including maternal gestational diabetes and gestation age at birth; one was community determined, eight were parent or family factors including maternal diet and level of physical activity and pre-pregnancy BMI, and four environmental risks, including maternal tobacco use. As seen within the earlier review (Weng, et al. 2012), in 34 of the 38 studies, a relationship was found between a higher BMI pre-pregnancy and overweight in later childhood. The review included 21 studies investigating gestational weight gain and, unlike the earlier review, demonstrated an association between maternal gestational weight gain and child overweight. As previously demonstrated (Weng, et al. 2012), smoking during pregnancy was also identified as a risk factor. Between birth and two years, a total of 21 possible risk factors were identified including high infant birth weight and accelerated infant weight gain. In particular, rapid weight gain was strongly associated with later childhood overweight or obesity, with 45 of the 46 studies showing a positive association. In addition, gestational diabetes was identified as a risk factor. Breastfeeding was demonstrated as protective within 23 of the 49 studies, 26 showed no association, so authors concluded that the evidence was inconsistent. Within one study, the introduction of solid foods prior to four months old was strongly and significantly associated with later obesity but only with formula fed infants. The other three studies showed no association (Woo Baidal, et al. 2016). Overweight or obesity was not found to be associated with maternal feeding style. Some studies indicate that inappropriate bottle use and delayed transition to a cup may be a risk factor, but such findings should be interpreted with caution due to the low number of studies exploring this factor. The main findings of the most recent review (Woo Baidal, et al. 2016) are presented in Table 1.

In summary, results from the two reviews indicate that high infant birth weight, rapid weight gain, a high pre-pregnancy BMI and smoking during pregnancy are associated with later risk of childhood overweight. The recent review also identified gestational weight gain as a risk factor (Woo Baidal, et al. 2016). Knowledge of these early life risk factors allows children most at risk of developing overweight and obesity in later childhood to be identified and targeted for early intervention. Individual risk factors found with a particularly strong association are discussed in more detail below, as are those that are still emerging.

Table 1 Risk factors for future overweight and obesity (Woo Baidal, et al. 2016)

Risk Factors Identified (strong)	Possible (less evidence)	Inconsistent	Insufficient evidence
Higher maternal pre-pregnancy BMI (38)	Gestational diabetes (35)	Breastfeeding (49)	Feeding Style (3)
Prenatal tobacco exposure (31)	Antibiotic exposure (5)	Complementary feeding <4 months (8)	Child screen time (1)
Maternal excess gestational weight gain (21)	Inappropriate bottle use (5)		
High infant birth weight (28)	Low strength of maternal-infant relationship (3)		
Accelerated infant weight gain (48)	Socioeconomic status (SES) (3)		
	Curtailed infant sleep (4)		
	Childcare attendance (2)		

(Number of studies)

2.4.1 Accelerated infant weight gain

The findings of the systematic reviews discussed above, support those of previous systematic reviews examining the association between rapid weight gain and later obesity risk and body mass index, (Baird, et al. 2005; Monteiro and Victora, 2005; Ong and Loos, 2006; Druet, et al. 2012). Evidence to date shows a consistent association although the way in which outcomes are assessed and weight gain defined varies and they have been criticised for their dissimilar study designs and populations (Zheng, et al. 2018). Zheng, et al. (2018) attempted to address this in a recent systematic review and meta-analysis of seventeen studies published between March 2006, since the last review (Ong and Loos, 2006) and January 2017. Inclusion criteria were studies reporting an association between rapid weight gain (RWG) during infancy (birth to two years) and subsequent overweight or obesity. Only those defining RWG as a change in weight-for-age z score of > 0.67 were included. The review concluded that children

experiencing RWG in the first two years of life were 3.66 times (95% CI: 2.59-5.17) more likely to become overweight or obese in later life.
Similarly, to the other reviews, the period of RWG and the age at which the outcome was measured was heterogeneous amongst the studies and age of overweight or obesity in later life ranged from two years to 46.5years. Outcome measures of adiposity varied between studies and there was no single measure that could be utilised across the life course of a child. The review supports existing evidence that RWG during infancy is a significant and independent risk factor for childhood overweight and obesity (Zheng, et al. 2018).

2.4.2 Prenatal tobacco exposure

Both systematic reviews identified smoking in pregnancy as a significant risk factor for later overweight (Weng, et al. 2012; Woo Baidal, et al 2016). The first review (Weng, et al. 2012) was based upon a meta-analysis of seven prospective studies and showed that children of mothers who smoked regularly during pregnancy were 47% more likely to be overweight compared with children whose mothers had not smoked (AOR 1.47, 95% CI 1.26-1.73). Although the authors reported that some publication bias was detected, the later review (Woo Baidal, et al. 2016) confirmed the findings, with 23 studies demonstrating an increased odds ratio of overweight in offspring associated with prenatal maternal smoking. Conversely, eight of the studies found no association. A systematic review and meta-analysis examining the risk of smoking in pregnancy verified the findings and reported a 37% (OR 1.37, 95% CI 1.28 to 1.46, I2 45%) increased likelihood of childhood overweight. A 55% increased likelihood of obesity was also found to be associated with maternal smoking in pregnancy from a pooled adjusted odds ratio of 39 studies (Rayfield and Plugge, 2017). The mechanism for this association remains unclear, although it has been suggested that it is mediated by smoking in pregnancy leading to a low birth weight (Wickstrom, 2007), which in turn may influence rapid weight gain (Gillman, 2010).

2.4.3 Higher maternal pre-pregnancy BMI

All three studies examining pre-pregnancy weight within the early systematic review (Weng, et al. 2012) found a strong association with childhood overweight and maternal pre-pregnancy overweight or obesity (Reilly, et al. 2005; Hawkins, et al. 2009; Rooney, Mathiason and Schauberger, 2011). Odds ratios varied between the studies, with the highest reported by Reilly and colleagues (2005). They found that children of mothers who were obese before pregnancy were 4.25 times (CI 2.86 to 6.32) more likely to be overweight at age seven, compared with the offspring of non-obese mothers. These findings were supported by the later review (Woo Baidal, et al. 2016) in which 34 articles

found a positive association between maternal overweight and overweight in later childhood. A systematic review and meta-analysis of 45 medium to high quality studies examined the relationship between pre-pregnancy BMI and infant birth weight, and offspring overweight/obesity (Yu, et al. 2013). Of the 45 studies, 12 explored the association between pre-pregnancy BMI and overweight/obesity in offspring but only four met the inclusion criteria for meta-analysis (Padez, et al. 2005; Gewa, 2010; Zilko, Rehkopf and Abrams 2010; Laitinen, et al. 2012). Results of the analysis showed that children of mothers who were overweight before pregnancy were nearly twice as likely to be overweight (OR, 1.95; 95% CI, 1.77–2.13) than mothers with a healthy BMI and three times as likely if obese (OR, 3.06; 95% CI, 2.68–3.49; P,0.001). This provides evidence that pre-pregnancy overweight and obesity increases the risk of subsequent offspring overweight and obesity.

2.4.4 High birth weight

Both systematic reviews found a strong association between higher infant birth weight and risk of later childhood overweight, (Weng, et al. 2012; Woo Baidal, et al. 2016). Results of the six relevant studies reviewed by Weng (2012) and colleagues were heterogeneous in terms of outcome measures and the age at which overweight and obesity were measured. The three studies using absolute birth weight as an outcome found that infants were approximately twice as likely to be overweight when their birth weight was above 4kg (Dubois and Girard, 2006), 3.86kg (Rooney, Mathiason and Schauberger, 2011) and 4.25kg (Ye, et al. 2010). The 24 studies within the 2016 review used inconsistent definitions of birth weight, some absolute weight (macrosomia) and others in reference to gestational age. Nonetheless, regardless of birth weight definition, there was an association between higher birth weight and later overweight. In addition, meta-analysis results have demonstrated that birth weight above 4kg is associated with childhood obesity, with high birthweight participants twice as likely (OR, 2.04; 95% CI, 1.87–2.21, P < 0.01) to be obese compared with those born 4kg or below (Yu, et al. 2011).

2.4.5 Excess gestational weight gain

Both excessive weight gain during pregnancy and gestational diabetes have begun to emerge as risk factors for later overweight and obesity. Due to the availability of only one study (Rooney, Mathiason and Schauberger, 2011) when the initial review was undertaken, there was insufficient evidence to conclude excessive gestational weight gain as a risk factor (Weng, et al. 2012). In the later review, it was associated with risk of childhood overweight in 19 out of 21 of the studies (Woo Baidal, et al. 2016). Excessive gestational weight gain is the difference in maternal weight between the first

prenatal visit and just prior to delivery. Within the review, some studies defined excess gestational weight gain as being above that recommended by the Institute of Medicine (IOM 2009) and others described as high, defined by various cut offs. Regardless of definition, an association was found in all 19 studies.

2.4.6 Gestational Diabetes (GDM)

There is also growing evidence to suggest that gestational diabetes, in particular high blood glucose levels during pregnancy, may be a contributing factor to the risk of childhood obesity (Woo Baidal, et al. 2016). Excessive glucose is thought to induce over nutrition and excessive foetal insulin levels, resulting in excessive foetal growth and metabolic disturbances that lead to childhood obesity (Zhu, et al. 2016). A review of 12 studies by Kim and colleagues (Kim, et al. 2011) concluded that findings were inconstant and inconclusive, primarily due to the heterogeneity in the criteria for the diagnosis of GDM and variation in glucose concentrations. Woo Baidal et al. (2016) reviewed thirty-three relevant studies of which two thirds demonstrated a significant association between gestational diabetes and childhood overweight, the remaining third showed no association (Woo Baidal, et al. 2016). As highlighted by Kim and colleagues (2011) there were issues of heterogeneity amongst the studies, and it was concluded that further research was required.

Despite the plethora of studies on nutritional exposure and risk of overweight and obesity the evidence remains inconclusive (Patro-Golab, et al. 2016). Key areas of research include the influence of breastfeeding, infant age of complementary feeding and the of formula milk composition. These are each discussed further below.

2.5.6 Breastfeeding

Weng and colleagues (2012) examined the impact of breastfeeding (defined as children who had ever been breastfed, including those exclusively breastfed or mixed fed in the first year of life) and results were mixed. From a total of ten studies, five showed a significant effect (Armstrong and Reilly, 2002; Bergmann, et al. 2003; Grummer-Strawn and Mei, 2004; Taveras, et al. 2006; Hawkins, et al. 2009) and five showed no effect (Reilly, et al. 2005; Shields, et al. 2006; Weyermann, Rothenbacher and Brenner, 2006; Kwok, et al. 2010; Seach, et al. 2010).The later review demonstrated similar findings and whilst 23 studies demonstrated a protective effect, 26 didn't (Woo Baidal, et al. 2016). Although the reviews (Weng, et al 2012 Woo Baidal, et al. 2016) were unable to demonstrate consistent evidence, when the studies were subjected to a meta-analysis, results indicated that ever being breastfed in the first year of life decreased the odds of childhood overweight by 15% (AOR 0.85, 95% CI 0.74-0.99) (Weng, et al. 2012).

Since these publications, systematic reviews of systematic reviews have demonstrated a consistent association between a reduced likelihood of overweight and obesity in child and adulthood, concluding that breastfeeding is indeed a protective factor (Patro-Golab, et al. 2016; Horta, Loret de Mola and Victora, 2015; Folders, et al. 2015). Pooled results from meta-analytical studies (Horta, Loret de Mola and Victora, 2015) have also demonstrated a pooled odds ratio of 0.87 (95%CI: 0.76; 0.99). So, based on the results from high-quality studies in both high-income and low- or middle-income settings, breastfeeding was associated with a 13% reduction in overweight/obesity. One of the review of reviews (Patro-Golab, et al. 2016) also indicated that breastfeeding for a very short duration is less protective than a longer duration on later risk of overweight and obesity. This conclusion was drawn from the results of four moderate quality reviews (Yan, et al. 2014; Hornell, et al. 2013: Weng, et al. 2012 and Owen, et al. 2005) and one of low quality (Harder, et al. 2016). The strongest evidence for an association was presented by the review and meta-analysis by Yan and colleagues (2014) in which a dose-response effect between breastfeeding duration (for seven months of more) and a 21% reduced risk of childhood obesity compared with those fed for less than seven months. The analysis included seventeen studies, but study quality was not assessed, so the reliability of the results should be interpreted with caution.

2.6.6 Complementary feeding

The reviews by Woo Baidal, et al. (2016) and Weng, et al. (2012) examined the impact of introducing solid foods prior to four months old on childhood overweight and obesity risk. Both included studies by Huh, et al. (2011) and Seach, et al. (2010) which demonstrated an association between the early introduction of solids and overweight Huh and colleagues (2011) demonstrated a significant effect on later risk of obesity at 3 years old in formula fed infants, with an odds ratio of 6.3 (95% CI 2.3-16.9) following adjustment for rapid early growth...In addition the 2016 review (Woo Baidal, et al. 2016) included the findings of Durmus and colleagues (Durmus, et al.2014) in which further support for an association between early introduction of solid foods and overweight was found.. However, there was an equal number of studies within the review (Woo Baidal, et al.2016) that showed no association, leading authors to conclude that the introduction of solid foods prior to four months is a risk factor for obesity, particularly amongst formula fed infants but overall, evidence is inconsistent. The conclusion that there is no consistent evidence of an association between introduction of complementary feeding prior to four months and measures of adiposity was also drawn from another review (Patro-Golab, et al. 2016).

The research presented above demonstrates the vast and evolving evidence base of the many risk factors present in early childhood that increase the chance of childhood overweight and obesity. This growing evidence of the early life risk factors has facilitated the development of childhood overweight and obesity risk prediction tools. Traditionally, risk assessment was focused upon clinical areas such as antenatal and cancer screening. However, this improved knowledge of the risk associated with chronic diseases has resulted in a proliferation of risk prediction tools, particularly in cardio-vascular disease (CVD), for which over 350 exist (Damen, et al. 2016). Others include those that predict risk of diabetes (Thoopputra, et al. 2012), gestational diabetes (Teede, et al. 2011) and adult obesity (Juonala, et al. 2011). Until recently, the obesity related literature has primarily focused upon obesity within the context of being a modifiable risk factor in the prevention of other chronic diseases such as CVD but is now seen as a chronic disease in its own right (Welschen, et al. 2012; Cameron, Magliano and Soderburg 2013). The next part of this chapter will discuss existing tools that can predict the future risk of childhood overweight and obesity and the implications for their use in clinical practice.

2.5 Childhood overweight and obesity risk prediction tools

A recent review identified 12 existing tools designed to predict overweight and/or obesity within childhood (Canfell, et al. 2018). Clinical prediction models such as these are known as prognostic models, as they aim to estimate the risk of an individual experiencing a particular outcome at a particular time. The development of such tools provides promising opportunities for identifying those at possible future risk of overweight and obesity, enabling early intervention (Redsell, et al. 2013) and could provide a more cost-effective intervention than population preventative actions (Morandi, et al. 2012). Despite the probable benefits of these tools, it is recognised that further research is required to further understand the reliability, feasibility and ethicality prior to their use in clinical practice (Weng, et al. 2013; Ziauddeen, et al. 2018; Canfell, et al. 2018; Butler, et al. 2019). One problem with the existing models is their heterogeneity. Variability between the models relates to a number of points, including: the source of original cohort data; risk factors/variables utilised in the model; the age at which overweight and/or obesity is predicted; the outcome measure and their predictive ability. A good summary of each of models is shown within the tables of the systematic reviews published (Canfell, et al. 2018; Ziauddeen, et al. 2018.

Perhaps of foremost importance is the models' statistical accuracy in being able to predict risk. Most commonly, predictive ability of a model is assessed using decision curve analysis (sensitivity:specificity) (Canfell, et al. 2018).

Sensitivity refers to the models' ability to correctly predict the individuals that already have or will develop the outcome, in this case overweight or obesity; specificity refers to the models' ability to correctly eliminate those who already have or that will not be at risk of developing it (Steyerberg, 2009). Although unrealistic, a perfect model would have 100% sensitivity and 100% specificity (Alba, et al. 2017). The point at which the models' risk threshold is set has an impact upon the sensitivity and specificity of the model and its ability to accurately predict those at risk or not at risk. For example, a risk threshold cut-off of 50% (Druet, et al. 2012) resulted in 83% sensitivity but specificity was only 51%, meaning that the tools would correctly identify 83% of the infants that would become obese but would also identify 49% of infants that would not become obese. Using Weng and colleagues' model (2013) as an example, at a prevalence level of 22.7% overweight, the model has a positive predictive value of 37%. This means that out of a cohort of 1715, 686 infants would be identified as high risk, but 433 infants would be misclassified as high risk. Of those not in the high-risk category (1029), 114 children would be misclassified as low risk and have the potential to become overweight based on a negative predictive value of 89%.

Unlike for CVD where thresholds are informed by clinical guidelines, there are no clinical guidelines to inform this decision for childhood obesity risk (Butler, et al 2019). In some cases, thresholds have been set arbitrarily (Morandi, et al. 2012), or set at various points without recommendations on which to use. The point at which a risk threshold is set has significant implications both ethically and in terms of resources required to support their use in practice. The impact of the risk thresholds requires careful consideration in order to balance the harm of treating an individual who will not need treatment, against the benefits of treating an individual who needs treatment. Models with high sensitivity and low specificity are more likely to result in high false positive rates. Conversely, those with low sensitivity and high specificity may fail to identify all those who are at potential future risk. Models with a higher sensitivity would provide a more universal approach and have been argued as preferable, given that obesity interventions (on those incorrectly classified as at risk) is unlikely to be harmful (Zhang, et al. 2009). However, this argument fails to appreciate the implications upon individuals, as a result of communication about their infants at risk status as well as significant resource implications, if the tool identifies many more requiring support and intervention. Given both the potentially emotive nature of such intervention coupled with increasing financial pressures on local authority public health budgets (The Kings Fund 2017) the implications of the threshold upon number of people it is likely to identify and how clinically manageable this is, requires careful consideration.

Another metric used to assess predictive ability is the area under the receiver operating characteristic curve (AUROC) which determines a model's ability to discriminate between those at high risk and those at lower risk (Alba, et al. 2017). Discriminative accuracy of tools is interpreted as anything on or above 0.70 as acceptable (Lee and Colagiuri, et al. 2013). Most of the current models are considered to have an acceptable or adequate AUROC but again, there is great variation between models, with the lowest at 0.64 (Manios, et al. 2016) and highest at 0.91 (Santorelli, et al. 2013).

Aside methodological considerations, the studies have been criticised for inadequate reporting (Ziauddeen, et al. 201; Canfell, et al. 2018;), something not exclusive to childhood overweight and obesity risk tools (Bouwmeester, et al. 2012). Ziuaddeen and colleagues (2017) evaluated ten prediction models designed to assess individual future risk of obesity and overweight in children. The models were assessed against Transparent Reporting recommendations for multivariate prediction models for Individual Prognosis and Diagnosis (TRIPOD) (Collins, et al. 2015). Amongst the models on average only 23 out of a recommended 37 items were reported. In addition to the issues discussed above, little is known about the feasibility of their use in clinical practice and the implications of tools upon health professionals and service users.

To date the existing models are not implemented into clinical practice but two have been developed into tools for use directly by parents or by health professionals with parents (Santorelli, et al. 2013; Redsell, et al. 2017). The first model to be converted for use by parents was developed into a smartphone application called ‘Healthy Infant Weight?’ (Santorelli, et al. 2013). The app allowed parents to find out their infant's risk of obesity at aged 2 years by entering information on birth weight, gender and change in weight between birth and 6, 9 or 12 months. Unfortunately, the outcomes were never published, and the application has since been discontinued due to a lack of funding (Butler, et al. 2019). Redsell and colleagues (2017) undertook a more comprehensive feasibility study in which the validated prediction model (Redsell, et al. 2016) was developed into a tool to support health visitors to assess and communicate risk to parents. The Proactive Assessment of Obesity Risk during Infancy (ProAsk) intervention sought to increase parents' understanding of childhood overweight, whilst also promoting self-efficacy for behaviour change (Redsell, et al 2017). It involved the assessment of risk in which items from a previously devised checklist, The Infant Risk of Overweight Checklist (IROC) (Weng, et al. 2013), were entered into ProAsk. Infant risk status was then calculated using the WHO growth charts (WHO, 2006). Predicted risk was presented to parents by a health professional with the use of a tablet device. For infants identified as being above the population risk, the output read ‘Your baby’s risk of

being above a healthy weight is more than other babies'. Those with the same risk as the population read 'Your baby's risk of being above a healthy weight is the same as other babies'. A health visitor then offered support to parents with infants above the population risk. Support was via a therapeutic wheel delivered as an interactive graphic upon a tablet device. It focused on evidence-based behaviour change strategies in sleeping and soothing, infant feeding cues, active play and milk and solid foods and was designed to be delivered alongside motivational interviewing. The study was novel in that it is the first to explore the feasibility of a risk communication and behaviour change intervention upon both health professionals and parents, but also due to its use of digital technology to support the delivery of the intervention.

The results of the ProAsk feasibility study (Redsell, et al 2017) demonstrated that both health visitors (n=15) and parents (n=12) found the study processes acceptable and the digital tool useful and engaging. However, recruitment targets were not meet and attrition rates were high. Methodological issues were also evident, in particular, adherence to the study protocol by health professionals. Incompatibilities between of the risk assessment and prevention strategies were thought to contribute to the low level of fidelity. With health professionals expressing difficulty to find the time to complete the behaviour change interventions. The use of digital technology to support delivery of the intervention had both pros and cons. Positively, the use of digital information was found to be visually engaging, interactive, easy to follow and accessible by most participants. However, health professionals new to using a tablet device, found it challenging (eight out of 15). Other authors exploring the role of multimedia within paediatric settings concluded that further research is required to understand the impact of multimedia on communication (Raaff, Glazebrook and Wharrad, 2014). Authors concluded that there was limited evidence to support the feasibility of adding ProAsk to HV's role without significant additional resources (Redsell, et al. 2017). The requirement for additional resources to support the use of risk assessment tools in clinical practice has also been called for in order to maximise the use of CVD tools (Kirby and Machen, 2009).

Although there is still more to understand about the feasibility of tools to predict the future risk of childhood obesity (Redsell, et al. 2017), their development provides an opportunity for both targeted and early intervention and the identification of high-risk infants. In line with the growing evidence of early life risk factors, interventions to prevent obesity in infancy have gained increasing attention from researchers. The next part of the chapter will discuss existing evidence of interventions during infancy.

2.6 Infant feeding interventions

In line with the growing evidence of early life risk factors, interventions during pregnancy and the first two years of life have gained increasing attention from researchers. To date, four systematic reviews of interventions designed to influence feeding practices, dietary intake and weight outcomes, have been published (Blake-Lamb, et al. 2016; Patro-Golab, et al. 2016; Redsell, et al. 2016 (A); Matvienko-Sikar, et al. 2018).

The Redsell et al. (2016 A) systematic review studied randomised control trials assessing the impact of interventions upon overweight or obesity (either directly or indirectly), delivered antenatally or during the first two years of life (Redsell, et al. 2016 A). The primary outcome measures were BMI, weight, weight gain velocity, weight-for-length and weight-for-age between birth and seven years old. Secondary outcomes included breastfeeding uptake and duration, timing of introduction of solid foods, dietary intake and quality, responsive feeding practices and physical activity. A total of 35 studies were eligible for inclusion, 24 of which were behavioural interventions (nutritional and/or responsive feeding, breastfeeding promotion and lactation support, parenting and lifestyle and maternal health) and three non-behavioural (formula milk composition). All three non-behavioural interventions examining the influence of the composition of formula milk demonstrated a positive impact upon weight outcomes. Infants who were fed a lower protein content formula had a significantly lower weight-for-age, weight-for-length z-score and BMI z-score at 12 months old, compared to those receiving higher protein content; at 24 months of age, weight-for-length z-score had remained lower (Koletzko, et al. 2009; Socha, et al. 2011; Escribano, et al. 2012). Hydrolysed infant formula was also demonstrated to have a positive impact upon the rate of growth, with slower BMI gains (Rzehak, et al. 2009) and weight-for-length z- scores (Mennella, Ventura and Beauchamp, 2011). The mechanism for this is believed to be a higher satiety factor with a hydrolysed formula, resulting in less overall intake of less formula (Mennella, Ventura and Beauchamp, 2011). Of the 24 behavioural interventions, several demonstrated improved feeding practices and positive impacts upon breastfeeding uptake, duration and exclusivity. However, only four were able to demonstrate a positive effect upon weight outcomes (Paul, et al. 2011; Daniels, et al. 2012; Wen, et al. 2012; Verbestel, et al. 2014). These are discussed in more detail below.

NOURISH is a randomised controlled trial evaluating the impact of an early feeding intervention on diet and obesity risk. The intervention is a skills-based three-month group programme delivered fortnightly to first-time mothers of heathy infants from

Australia (Daniels, et al. 2009). Post intervention, at nine months, children in the intervention group demonstrated a significantly lower BMI-for-age z-score compared to the control group (0.23 + 0.93 vs 0.42 + 0.85). Rapid weight gain (defined as change in weight-for-age-z-score of > +6.7) was also more likely in the control group compared to the intervention group (OR 1.5, CI 95%, 1.1-1.2, p=0.014) (Daniels, et al. 2012). When assessed again at 13-15 months old, BMI-for-age z-score in the intervention group remained lower within the control group (0.23 vs 0.42 p=0.009). No significant difference was seen, however, at age two years, suggesting that the reduced BMI-for-age z-score was not sustained (Daniels, et al. 2013).

The SLIMTIME trial (Paul, et al. 2011) explored the impact of two interventions upon 110 mothers of new-borns. Mothers intending to breastfeed were recruited and randomised to either a soothe/sleep intervention arm and/or introduction of solids arm. The soothe/sleep intervention taught parents alternative soothing and calming strategies designed to increase sleep duration. The introduction of solids taught parents about hunger and satiety cues and appropriate timing to begin weaning. The primary outcome was weight-for length at age one. After a year of exposure to the intervention, infants within both groups had a lower weight-for-length percentile (Paul, et al. 2011).

The Verbestel, et al. (2014) study was a family-based lifestyle intervention delivered to 203 mothers of infants between nine months and two years, attending child day care centres in Belgium. The aim of the intervention was to increase consumptions of water, milk, fruit and vegetables and daily physical activity and decrease consumption of sweets and savoury snacks and screen-time behaviour. After a year, there was no significant effect upon diet and physical activity behaviours. In fact, some behaviours became less healthy in both the control and intervention group. Despite this, a positive impact on BMI z-score was demonstrated. A BMI reduction was seen in both the intervention and control group but was greater in the intervention group (1.33-0.38 p<0.001). Results of the study should be interpreted with caution due to low participant numbers, lack of blinding and the use of self-reported parental questionnaires to gather data (Verbestel, et al. 2014).

The Wen, et al. (2012) intervention promoted breast feeding, appropriate timing of introduction of solids, active play through “tummy time” and family nutrition and physical activity to 667 first time mothers of infants in Australia. The Healthy Beginnings trial was delivered by trained community nurses during eight home visits between gestation and 24 months. The effects of the trial were measured at six, 12 and 24 months. The primary outcome was weight-for-length at two years, and secondary outcomes, mother

and child diet and physical activity behaviours. Results of the study demonstrated a positive impact upon both behaviours and weight outcomes, with a BMI reduction of 0.29 kg/m2 (p <0.04) (Wen, et al. 2012). The four interventions that demonstrated an impact upon weight outcomes, differed considerably in their intervention curriculum as well as dose and time of delivery. However, all included components to encourage parental responsiveness to infant feeding cues.

The Blake-Lamb, et al. (2016) systematic review appraised interventions implemented in the first 1,000 days, pre or peri-conceptional, pregnancy and infancy (up to 24 months) published up until December 2014. All studies included prevention of childhood overweight or obesity between six months and 18 years as an outcome measure. The review identified 34 studies, of which 26 were unique interventions. Of these, seven demonstrated a positive impact on weight, four of which (Paul, et al. 2011; Verbestel, et al. 2014; Wen, et al 2012; Daniels, et al. 2012), were the same studies identified in the Redsell, et al. (2016) review discussed above. In addition to these, an intervention delivered by community health workers through home and group visits showed a reduced BMI z-score of 0.31 (p<0.001) and reduced risk of overweight by 57% (p<0.005) at 13-24 months (Navarro, et al. 2013). There were also two clinic-based interventions. One showed a slower rise in BMI z-score between two and four years of age, although effect sizes were small (-0.034 to -0.002 p0.028) (Mustila et al. 2012). Another, the STRIP, showed a lower prevalence of overweight at ten years old (10.2% vs 18.8% in controls, p=0.04) but with girls only (Hakanen, et al. 2006). Interventions exploring the impact of formula milk composition upon growth velocity showed that hydrolysed and high protein formulas were associated with greater risk of obesity at age six and fat mass between the ages of five and eight (Koletzko, et al. 2009; Rzehak, et al. 2009; Weber, et al. 2014; Singhal, et al. 2010).

The Patro-Golab, et al. (2016) review explored the impact of nutritional interventions on overweight or obesity risk within children from birth to three years old.
The review included only systematic reviews of randomised controlled trials and observational studies published up to September 2015. It investigated the influence of breastfeeding (duration and exclusivity), infant formula (protein content, soy formulas, content of long chain polyunsaturated fatty acids, probiotics), complementary feeding (introduction time; type of food) and dietary intake in early childhood (protein, fats, sugars, energy and fruit and vegetables). Quality of the studies was assessed using the Assessment of Multiple Systematic Reviews (AMSTAR) tool. The review found no strong evidence that any of the nutritional interventions were able to consistently reduce

the risk of overweight or obesity. A weak association between a modest reduction in the future risk of overweight and breastfeeding was seen for lower protein infant formulas.

The most recently published review (Matvienko-Sikar, et al. 2018) examined the effects of early feeding interventions delivered by health care professionals. Unlike the other reviews, this one included case-control and quasi-experimental studies as well as trials, published up to May 2017. Outcome measures were impacts upon parental feeding practices, dietary intake and weight outcomes in children up to the age of two years old. The review identified a total of 16 eligible studies; ten of these were categorised as trials but only nine used a randomised design. The authors concluded that outcomes on feeding practices, dietary intake and weight outcomes were inconsistent. In support of existing research (Redsell, et al. 2016), interventions with some component of responsive feeding demonstrated the greatest promise for improving feeding practices and weight outcomes (Matvienko-Sikar, et al. 2018).

Responsive feeding refers to feeding practices that encourage a child to eat autonomously and in response to physiological needs. Such practices promote self-regulation in eating, as well as supporting cognitive, emotional, and social development in young children (Pérez-Escamilla, Segura-Pérez and Lott 2017). The aim is to enable self-regulation through appropriate response to infant hunger and satiety cues. Responsive parenting provides the theoretical framework for responsive feeding, the roots of which stem from child development theories such as attachment and socialisation (Ainsworth, et al. 1978; Bugenthal and Goodnow, 1998, pp.389-462). It is conceptualised as having four key steps: caregiver creation of routine, structure, expectations and emotions that promote child caregiver interaction; child signalling of need through expressions or vocalisation; caregiver recognition of signals and prompt response, leading to the child experiencing a predictable response (Eshel, et al. 2006; Black and Aboud, 2011). Responsive parenting is not necessarily about complying with a child's request, particularly if inappropriate, but about responding to it (Black and Aboud, 2011). Enhancing maternal responsiveness results in better child health and development (Eshel, et al. 2006). Evidence now also suggests that educational strategies using a responsive feeding framework may positively influence infant behaviours such as sleep, that contribute to later obesity (Pérez-Escamilla, Segura-Pérez and Lott, 2017).

Six trials within a recent review (Matvienko-Sikar, et al. 2018) included some component of responsive feeding. Although the type and number of components varied, findings demonstrated the positive effect that responsive feeding interventions delivered by

health care professional can have on feeding practices and weight (Matvienko-Sikar, et al. 2018). Trials that included responsive feeding were the NOURISH trial (Daniels, et al. 2012); Intervention Nurses Start Infants Growing on Healthy Trajectories (INSIGHT); (Hohman, et al. 2017); Introduction to Solids (ItS) (Paul, et al. 2011); Growing Leaps and Bounds (GLB), (Schroeder, et al. 2015); The Ounce of Prevention (OoP), (French, et al. 2012); and The Starting Early Intervention (Gross, et al. 2016).

The NOURISH trial showed benefits on parental feeding responsiveness, emotional feeding and controlling feeding (Daniels, et al. 2013; 2015) when compared to similar interventions without responsive feeding components (Fangupo, et al. 2015). Parents in the intervention group exerted more dietary restriction on their child ($P < 0.01$) and were more active in monitoring child feeding ($p < 0.05$). One study showed that parents in the intervention group were more inclined to monitor child feeding and restrict their child's diet (Schroeder, et al. 2015). Results for instrumental feeding and pressure to eat were inconsistent: pressure to eat was reduced in interventions, with or without a responsive feeding element. Conversely, interventions without a responsive feeding component demonstrated greater success in delaying the introduction of solids (Wen, et al. 2011) compared to those with the feeding component. Findings in relation to positive impacts upon weight gain were inconsistent across both types of intervention, although those with a responsive feeding element demonstrated marginal improvements on reduced BMI and skinfold thickness at one year (Daniels, et al. 2012; Schroeder, et al. 2015). However, as discussed previously, the NOURISH trial failed to demonstrate a sustained impact upon weight.

Evidence in support of the positive influence of responsive feeding practices upon weight is growing. Of interest is the INSIGHT study (Paul, et al. 2014). The INSIGHT responsive parenting curriculum focuses on four domains of infant behaviour: drowsiness, sleep, fussiness and alertness. The central hypothesis of the trial is that responsive feeding guidance focused on how to recognise and respond to infant cues of huger and satiety may promote self-regulation, reduce non-responsive feeding, thereby reducing the risk of overeating and subsequent overweight. The INSIGHT intervention is delivered in parents' homes by trained nurses at three, six, 16, 28 and 40 weeks after birth. Dietary components include guidance on what, when and how to feed. The 'how' includes: recognition and response to infant hunger and satiety cues; alternatives to using food to soothe; and use of structure based non-controlling feeding practices to promote shared control. The intervention was effective at positively influencing dietary patterns of formula fed infants at aged nine months and was significantly associated with BMI percentile at two years (Hohman, et al. 2017). Impacts upon feeding practices

were also demonstrated, and at four to eight months old, mothers in the intervention group were less likely to use non-responsive feeding practices, such as pressurising their infant to finish the bottle and using food to soothe (Savage, et al. 2018). Increased sleep duration (Paul, et al. 2016) and reduced screen time and television exposure (Adams, et al. 2018) were also demonstrated. To date, within the intervention group, the trial has demonstrated reduced rapid weight gain during the first six months after birth, a lower weight-for-length and prevalence of overweight status at aged one year (Savage, et al. 2016) and a reduced BMI z-score at age three (Paul, et al. 2018). These findings demonstrate a sustained outcome, beyond that of one to two years old shown in other studies (i.e., Daniels, et al. 2012; Wen, et al. 2012; Paul, et al. 2011). Secondary outcomes of BMI percentile and proportion of children who were overweight and obese at three years old were not statistically significant (Paul, et al. 2018).

A recent trial assessed the impact of reduced formula milk on rapid weight gain among formula fed infants (Lakshman, et al. 2018). The aims of the intervention were to reduce formula milk intake (in line with 2004 WHO EAR for energy), promote responsive feeding and monitor growth in order to influence weight and prevent rapid weight gain. The responsive feeding components of the trial included encouraging mothers to recognise infant feeding cues, not to force infants to finish the bottle, recognise that crying is not always due to hunger and not to feed the infant every time they cried (Lakshman, et al. 2015). The intervention group showed a slower weight gain at six months compared to the control but there was no significant impact on the primary outcome, which was reduced prevalence of weight gain at twelve months (Lakshman, et al. 2018).

Overall, in many cases existing studies are unable to provide evidence of longer term, sustainable outcomes on weight and diet. The small effect sizes of current interventions should also be acknowledged and absolute differences between BMI z-score are small across the studies. For example, within INSIGHT, the rate was only -0.28 at three years old (Paul, et al. 2018) and - 0.19 (Daniels, 2012). Although the first meets the threshold of 0.20 to 0.25 considered to be clinically relevant (Grossman, et al 2017), it fails to achieve 0.67, the point at which weight gain is shown to impact upon later obesity risk (Zheng, et al. 2018). It is also worth noting that INSIGHT is only delivered to first time mothers and that outcomes amongst mothers with multiple children is therefore unknown. Blake-Lamb and colleagues (2016) argue that current study designs are too focussed upon individual level diet and physical activity behaviours and in doing so, fail to consider the wider social context of influences upon obesity, such as government policy and how the food industry may influence behaviour. They suggest that future

interventions should be designed within a framework of these wider social and environmental influences, such as their collective-impact model (Blake-Lamb, et al. 2016).

Perhaps one of the most significant points to recognise is the heterogeneity of the reviews and trials regarding their content type and length, the primary and secondary outcomes and the points at which these are measured. The evidence includes a plethora of outcome measures for not only weight indices but also feeding practices and dietary intake. These inconsistencies present challenges for direct comparison and identification of successful components across studies. The lack of standardisation across infant feeding interventions is well recognised and, to address this, a core outcome set for childhood obesity interventions has been developed (Matvienko-Sikar, et al. 2020). Components of responsive feeding as well as how they are measured, also varies. Heller and Mobley (2019) recently identified over 33 instruments measuring at least one aspect of responsive feeding (food rewards, pressure to eat, parental control of intake, emotional feeding or responsive to cues/child autonomy), concluding that there is currently no one instrument that measures all aspects of responsive feeding practices.

There are also questions about the most appropriate weight indices to use in order to capture the outcome of an intervention. Aside from the use of different indices across studies, Reilly, et al. (2017) argue that proxy measures of adiposity such as BMI or BMI z-scores may not be the most appropriate.

Whilst there is still further research needed to demonstrate the effects of interventions on longer term weight outcomes, the positive impacts of the current interventions are evident. The systematic reviews discussed provide strong evidence of both reduction in BMI and influence on feeding practices that may positively influence weight (Blake-Lamb, et al. 2016; Patro-Golab, et al. 2016; Redsell, et al. 2016 (A); Matvienko-Sikar, et al. 2018).

Evidence of these successful interventions during infancy and within young children, present great opportunities for the early prevention of childhood obesity. As demonstrated within the literature, the success of many of these individual level interventions would not be possible without the involvement of parents. Parents are key stakeholders in the prevention of childhood obesity and parent involvement in both obesity prevention and management efforts have been stressed (Epstein, et al. 1994; Nichols, et al. 2015; Golan, 2006). The next part of this chapter will discuss the current

literature on parental engagement in childhood obesity and examine the factors that may positively or negatively influence parental engagement.

2.7 Parental Engagement

Parental engagement is a multifaceted, dynamic and complex process that remains inconsistently defined in studies (Samra, et al 2015)). Current research is dominated by parental engagement in parenting programmes (see for example, Chacko et al. 2016; Gonzalez, Morawska and Haslam, 2018), education (Emerson, et al. 2012; Goodall and Montgomery 2014) and child welfare services (Kemp, et al. 2014). Parental engagement within healthcare is less researched and existing studies are focused on child mental health prevention and treatment services (see for example, Finan, et al. 2018; Ingoldsby, 2010; Morrissey-Kane and Prinz, 1999).

The term 'engagement' is often used synonymously with participation, recruitment or retention, completion, and attendance (Baker, Arnold and Meagher, 2011; Whittaker and Cowley, 2012). Due to the lack of a standardised definition, the quantitative measurement of engagement is also inconsistent, presenting challenges for comparisons of findings across research studies (Finan, et al. 2018). Only three existing instruments that measure or quantify parental engagement in healthcare were found within the literature (Kroll and Green 1997; Kearney and Byrne. 2011; Samra, et al. 2015), none of which were related to obesity. The most recent tool was designed to predict and identify low engagement in at risk parents of pre-term infants, for use in neonatal intensive care units (Samra, et al. 2015). Within this study, authors also created a new multidisciplinary model of parental engagement based on themes from the theoretical literature. The model sought to explain the relationship between parent and healthcare inputs and proposed that matching inputs would result in improved parental engagement. The model was then used to develop a new instrument, The Parent Risk Evaluation and Engagement Model and Instrument (PREEMI). The resulting scale had five subscales: knowledge, perception of risk, support and resources, outcome expectations and self-efficacy. Although not related to childhood obesity prevention, the model provides useful insight into the concepts of parental engagement. Conceptual frameworks and models of engagement are discussed in more detail within Chapter three.

The existing research on parental engagement and obesity is focused on child weight management and attendance or attrition are the primary measures of engagement (Skelton and Beech 2011). Despite the importance of parents' involvement in childhood obesity (Epstein, et al. 1994) research suggests that recruitment and retention to weight

management programmes is challenging, and poor engagement is common (Skelton and Beech 2011). Due to the problem this presents for health outcome and cost effectiveness, understanding the predictors of non-attendance to weight management programmes has become an area of focus for researchers (Dhaliwal, et al. 2014; Nobles, et al. 2016; Kelleher, et al. 2017

A recent systematic review used a narrative approach to identify the existing evidence of factors influencing family non-attendance in community-based programmes for overweight and obese school aged children (Kelleher, et al. 2017). Following the identification of 1405 articles, only 13 studies met the inclusion criteria, of which five were qualitative, six quantitative and two mixed methods. Non-modifiable factors such as age, gender, ethnicity as well as modifiable facilitators and barriers of engagement (as perceived by parents) were explored. The review found that families of overweight and obese girls were more likely to both enrol, and complete programmes compared to families of overweight and obese boys, and families from ethnic minorities were more likely to drop out. Lone parenthood and lower socioeconomic status were associated with higher dropout and recruitment challenges were faced in deprived areas. Modifiable 'participant related' facilitators to attendance included parental concern for child health and well-being, and a desire for social interaction and support. As reflected in previous studies (e.g., Eli, 2014), parents' primary concerns related to the psychological health of their child and fears of bullying. Barriers to attendance included concerns amongst children about the stigma attached to attending a 'fat club' while for parents, fear of negative comments by friends and family was a concern. The review also identified parental denial of childhood overweight as a barrier to recruitment.

To date, there is only one study on parental engagement in the prevention of childhood obesity (Love, et al. 2018). The study examined factors that enabled and facilitated engagement, (measured as attendance) of first-time mother of infants in a prevention programme (Love, et al. 2018). The programme was called the 'Infant Programme' and offered group-based, face to face support for a period of 18 months (Campbell, et al. 2013). Study results were categorised into three themes thought to influence engagement: personal, organisational and programme factors. Personal factors included the transition to parenthood, which was found to be an enabler to attendance, primarily due to the desire for information and knowledge, particularly about infant feeding. Although some parents articulated this as desire for information, those with low attendance rate and parents with lower levels of education, relied more upon informal sources of information, and viewed them as a substitute to attendance. Information sources included family members, friends with children, the internet and social media.

However, both low and high attendee parents sought reassurance and affirmation about infant feeding. Parents also expressed a desire for social interaction and connections with other parents. These factors emerged from the study by Kelleher (2017). First time parenthood positively influenced engagement, yet it also posed barriers to attendance due to the very challenge of having a new baby, and mothers expressed this as a stressful or overwhelming time. Adjusting to their baby's routine hampered attempts to attend, especially if it meant interrupting their infants' sleeping routine, as did mothers returning to work. During the 18-month programme, attendance dropped at two time periods, once when infants were about nine months old and again at 12 months. Low attendees and service providers agreed that this was due to a growing sense of confidence as a parent, especially once the infant had transitioned to solid food.

The above research identifies factors that may influence parental engagement; however, more research is needed, particularly in relation to the prevention of childhood obesity. As discussed, the purpose of this research is to understand more about parent perceptions of infant overweight and the identification of future obesity risk, to enable the identification of the potential barriers to parental engagement in the prevention of childhood obesity. It was therefore considered important to review the existing available literature on parents' perceptions of overweight children in the early years.

2.8 Parental Perceptions

Parental recognition of the overweight status of their child is recognised as a key initial step to engaging parents in obesity prevention (Mareno, 2014). Parental perception of childhood weight status is well researched and suggests that 50-70% of parents incorrectly perceive their child's overweight status against objective measures of body weight (Rietmeijer-Mentink, et al. 2013; Lundahl, Kidwell and Nelson, 2014; and Tompkins, Seablom and Brock, 2015). The inability of parents to recognise overweight and obesity has been proposed as an explanation for poor parental engagement (Parry, et al. 2008). Inaccurate parental perceptions and concerns about childhood overweight are potential barriers to parental intervention to prevent further weight gain (Warschburger and Kroller, 2012) and are also believed to influence maternal feeding practices (Musaad, Donovan and Fiese, 2015; Harrison, et al. 2018).

Less is known about perceptions of weight during infancy, although evidence is growing (Kroke, Strathmann and Günther 2006; Brown, et al. 2016; Harrison, et al. 2018). A recent Australian study of 263 mothers with infants between five and thirteen months,

concluded that over a third (35.3%) of mothers misinterpreted their infants' weight by either overestimating underweight or underestimating overweight. (Harrison, et al. 2018). Almost all the mothers, 39 out of 40 (97.5%) with an overweight infant underestimated infant weight and categorised them as a healthy weight. An earlier study with a comparable sample size (253), also found that approximately a third (31%) of mothers misclassified child weight at aged 6 months of age, although the percentage underestimating overweight (>85th percentile) was smaller at 59% (Kroke, Strathmann and Günther (2006). A large study from the US examined parental perceptions at aged two, four, six, nine and 12 months old. Results identified that 74%-93% of mothers underestimated their infants' overweight (<95th percentile) (Brown, et al. 2016). Accuracy of parents' perception of overweight was influenced by the age of the infant, with accuracy increasing in the first six months, before falling to its lowest point at 12 months old (Brown, et al. 2016). The influence of infant age on accuracy was also seen within a German study (Kroke, Strathmann and Günther 2006). A higher maternal BMI was associated with parent underestimation of infant overweight (Brown, et al. 2016) as also shown within mothers of toddlers (Byrne, Magarey and Daniels, 2016) and of older children (Rietmeijer-Mentink, et al. 2013).

Poor perception of infant weight status has also been associated with feeding practices (Blissett and Farrow, 2007; Brown and Lee, 2011; Musaad, Donovan and Fiese, 2015; Harrison, et al. 2018). Brown and colleagues found that mothers who perceive their infant to be large at six months, exert less controlling or pressured feeding practices (Brown and Lee, 2011). A recent Australian study of 263 mothers of infants aged five to thirteen months, investigated the associations between maternal perception of infant weight on feeding and dietary intake (Harrison, et al. 2018). Associations explored included: maternal concerns about infant weight; maternal feeding practices (restriction, pressure-to eat and monitoring); infant dietary intake and parenting style (hostility, warmth). Results found that maternal concerns regarding underweight were more prevalent and likely to influence feeding than overweight concerns. Positive associations were found between underweight concern, pressure to eat and early introduction of solids. Conversely, concerns about overweight were associated with restrictive feeding practices. The only feeding practice to be associated with both dietary intake and under or overweight outcome, was pressure-to eat, with the odds of infants being overweight 50% lower with pressure to eat (OR 0.50, 95% CI 0.30-0.84). Despite this, no direct association was found between infant weight and dietary intake (Harrison, et al. 2018).

Existing qualitative studies exploring parent perceptions of infant weight, although still limited, provide some valuable insight into factors that could positively or negatively

influence attempts to engage parents in prevention during infancy. In line with the HBM (Rosenstock, Strecher and Becker, 1988), perhaps of foremost importance are the perceptions held about the susceptibility of infants to being or becoming overweight and how serious this is perceived to be. A recent study exploring mothers' perceptions of infant obesity demonstrated some uncertainly when talking about whether an infant could be overweight. Although the majority thought infants could be overweight, they responded using terms such as ‘I guess’ or ‘I think it could be possible’ and did not personalise or discuss overweight in relation to their own infant (Dinkel, et al. 2017). Beliefs differed, depending upon method of feeding, with a strong belief that breastfed babies cannot be overweight, ‘I think it is impossible for a breastfed baby to be overweight’. A small number of mothers did not support the idea that it is possible for an infant to be overweight, regardless of their feeding method (Dinkel, et al. 2017). This supports earlier findings showing that some mothers believed it was not possible to overfeed babies or for them to gain excess weight as infants (Lakshman, et al. 2012).

This body of research, albeit limited, suggests that parents perceive the method of feeding as influential upon infant weight, with breastfeeding seen as protective. This is supported by a study by Dinkel, et al. (2017), in which parents cited overfeeding of formula milk and the early introduction of solids as causing of overweight in infancy. There was also a strong belief that breastfed infants could not be overweight and only those on formula could be overfed (Dinkel, et al. 2017). These causal attributions imply some level of parental responsibility for overweight. Evidence of parents’ perception on the causes of childhood overweight, their responsibility for this and possible solutions are limited, particularly in relation to younger children. Two studies that do address this are Douglas, et al. (2014) and Dinkel, et al. (2017). The latter is a qualitative study of mothers of pre-school children. It explores views on factors responsible for childhood obesity, the parents’ role in managing obesity, views about their own child’s weight and the response to being told by a health professional that their child was overweight (Douglas, et al. 2014). Within causes of overweight, a prominent theme was ‘parental failure’, with numerous examples of how other parents had failed to provide a healthy diet due to a lack of knowledge of what is healthy. Some parents perceived themselves as inadequate or deficient as parents, admitting giving convenience foods when short of time or too tired. Another theme was ‘parental responsibility to get the balance right’ which emerged in relation to questions asked about what is required to raise a healthy weight child (Douglas, et al. 2014).

Little is known about the factors that influence parents' perceptions of the risks and consequences of infant overweight. In a qualitative study exploring the views of thirty-

eight parents of infants on infant size and growth, overweight and obese parents did not raise concerns regarding the health risks of obesity (Redsell, et al. 2010). Authors suggested this was likely due to a failure of parents to personalise and acknowledge their own infant as at risk, as opposed to a lack of concern. An absence of concern could be explained by the common perception that infants will grow out of being overweight or 'level out', therefore delaying health concerns (Redsell, et al. 2010) or that health risks of childhood obesity during infancy are not yet realised. It could also indicate that parents are unaware of the health risks. In older children, it is proposed that parental concern is influenced more by quality of life and functional abilities, such as teasing or hindering leisure activities, rather than health concerns (Peyer, et al. 2015). This is supported by the findings of an earlier American study of 18 low-income parents of pre-school children which found that a child's weight only became a concern to them if the child became inactive or was being teased by peers (Jain, et al. 2001).

Redsell and colleagues (2010) also explored views on identifying the risk of future obesity. The study revealed several potential barriers to the early identification of future obesity risk, including parental uncertainty about identification and about management of obesity in infancy (Redsell, et al. 2010). Mothers identified as above a healthy weight themselves, expressed a preference for larger babies, due to the belief that having a bigger infant was healthier. Interestingly, in discussion about preference for a bigger baby, they did recognise that this was less socially acceptable than it had been in the past (Redsell, et al. 2010). Being larger during infancy was attributed to family history accompanied by a sense of learned helplessness. These mothers also demonstrated a reluctance to identify their infant as overweight whereas this reluctance was not seen amongst their healthy weight counterparts. The preference for a bigger baby, due to the belief that bigger babies are healthier, is not exclusive to overweight mothers. (Harrison, Hepworth and Brodribb, 2018; Laraway, et al. 2010). Harrison, et al. (2017 describe this as a 'safety net' in the sense that heavier infants are safer, a finding that also emerged in an earlier study (Kaufman and Karpati, 2007). Parents also described how bigger babies affirmed good parenting (Higgins, 2000). The relationship between health and overweight proposed by parents highlights the longstanding parental fears about childhood underweight, with more mothers reporting concerns of under rather than overweight (Heinig, et al 2006; Chan and Wang, 2013).

Redsell, et al. (2010) also identified a theme around the timing of risk communication with parents, expressing a strong view that professionals should not be assessing infants "at risk" or introducing management plans, until the infant is physically active at around a year old. This was underpinned by the belief that an infant's weight levels out

at one year. The issue of timing was similarly raised in a study, that explored parents' views of an intervention to prevent excess weight gain during infancy, in which mothers expressed that it was too early to worry about obesity (Lakshman, et al. 2012).

Some parents believed that there was shame and stigma attached to having an overweight or obese infant and expressed fears of criticism and judgement from others, including health professionals, family and peers (Redsell, et al. 2010). The fear of being judged was also seen amongst parents of preschool children (McKee, et al. 2010), in a study investigating the acceptability of an obesity prevention programme to address behavioural risk for obesity in pre-school children. Parents expressed discomfort and resistance to a diagnosis of obesity and there was a lack of trust in relation to how obesity is determined. Parents suggested that physician's charts were wrong, or not appropriate for their child, due to their baby being "off the chart" since birth (McKee, et al. 2010). Obesity stigma is well-researched, and adults and children alike can hold stigmatising views. Children as young as two or three years old displayed negative attitudes towards overweight people (Turnbull, Heaslip and Mcleod, 2000) as did mothers, both in relation to children in general and to their own children (Holub, Tan and Patel, 2011). School aged children can fall victim to teasing and bullying from peers because of their weight, and many children believe that overweight children are ugly, stupid and have no friends (Musher-Eizenman, et al. 2004). There is also a culture of blame with parents, particularly mothers, seeming to attract blame for their child's weight (De Brun, et al. 2012). Given this, it is perhaps not surprising that parents are reluctant to identify or label their child as overweight and that the issue of stigma and judgment present significant challenges for engaging parents in interventions in which their child is identified as overweight.

The existing evidence highlights the factors perceived by parents as being barriers to both receptiveness and engagement in conversations about infant weight, acknowledgement of weight status and its consequences and the decision to engage in the assessment of obesity risk assessment. As well as the perceptions held by parents, the existing literature also examines the challenges from the perspective of health professionals in terms of supporting families to prevent and manage childhood obesity. This literature is now discussed.

2.9 Perceptions of Health Care Professionals

Talking about childhood obesity has been referred to as a health communication dilemma (Mikhailovich and Morrison, 2007) and to date, best practice and evidence-based guidance for weight related communication is lacking (McPherson, et al. 2016). A

re-occurring barrier perceived by nurses is the fear or concern that talking about weight may negatively impact upon building a rapport with patients or that they may offend patients, and this will impact on building an effective relationship (Edvardsson, Edvardsson and Hornsten, 2009; Laws, et al. 2015). Other barriers to raising the issue with parents include the perception that parents will not be receptive to lifestyle advice due to their own lifestyle and a lack of knowledge or skills (Laws, et al. 2015). Health care professionals also perceive that parents are not concerned about infancy overweight due to preference for larger babies or parent satisfaction of having a well-fed baby (Redsell, et al. 2013). Studies suggest that health care professional can feel undermined when parents reject their messages, perceiving that parents do not like what they are saying (Redsell, et al. 2013). There is also a concern that even when the parents initially respond positively, they then ignore recommendations and onward referrals that are made (Isma, et al. 2013).

Due to the relative infancy of risk tools to predict childhood overweight and obesity, evidence of their acceptability from a health professional perspective is limited. It is imperative that health professionals both believe in the value of obesity risk assessment and feel able and confident to deliver risk information to parents. The existing literature clearly demonstrates the challenges of providing such information to parents, as perceived by health professionals. Within a study exploring health professionals' views on infant overweight, participants openly discussed the lack of scientific knowledge to support communications about infant obesity and the uncertainty about the risk factors for obesity that can be identified in infancy (Redsell, et al. 2013).

The ProAsk study also highlighted reservations amongst health visitors about assessing the risk of obesity during infancy. This was underpinned by the belief that it was too early for personalised risk communication or by concerns about the unintended consequences of communication (Redsell, et al. 2017). Reservation amongst health professionals is also reported Redsell, et al. (2010). Evidence suggests that although health staff acknowledge that some infants demonstrate excess weight gain, there is a lack of recognition that an infant could be identified as overweight or obese (Redsell, et al. 2011 and Redsell, et al. 2013). The ProAsk study also suggested that health visitors tended to disregard or discount a result of ‘above population risk’. The authors suggested that this could indicate a lack of confidence about raising the issue generally and discussing with parents the results of risk assessment, especially negative results. In support of this, there was a lack of adherence to the study protocol, which involved health visitors providing feedback to parents on their risk score and goal setting, which in many cases was not performed. Reluctance and lack of confidence amongst health

professionals to identify infants as overweight and discuss this with parents is exacerbated if the parent is overweight (Edvardsson, Edvardsson and Hornsten, 2009), due to fears that they may be perceived as judging the parent. A similar fear was raised by professionals within the ProAsk trial (Rose, et al. 2019).

On the other hand, the use of tools such as growth charts and digital technology in the form of a tablet, were viewed by professional as useful and objective tools that could help facilitate conversations about weight (Regber, Marild and Hanse, 2013; Rose, et al. 2019). This is noteworthy, given that the reported use of the growth charts to assess infant weight is inconsistent amongst nurses in the UK. It is concerning that UK health professionals, including paediatricians, GPs and paediatric nurses, are unable to accurately identify children as overweight or obese by observation alone (Smith, Gately and Rudolf, 2008). It also has negative implications for both identifying those children most at risk and raising awareness and engaging parents in intervention and conversations about their child's weight. More research is required to understand the barriers to the use of charts in UK practice and a need to understand if it is a training need or if it is due to a culture that is afraid to have the conversation. This could also reflect the traditional use of growth charts to reassure parents about adequate weight gain and not the identification of excess weight gain, an area professionals feel less comfortable and confident to do. A further obstacle to preventative action by nurses is the lack of onward referral or dietetic support available once the issue is raised (Isma, et al. 2013) and some nurses reported feeling undermined by paediatricians and GPs who dismiss the severity of overweight in infants (Isma, et al. 2013).

2.10 Conclusion

The growing body of evidence regarding the risk factors for overweight and obesity alongside the development of childhood obesity risk prediction tools, provide promising opportunities for early and targeted intervention. The importance of involving parents in obesity prevention is undisputed. To date, literature on the involvement or participation of parents in childhood obesity, focuses on attendance of managing and preventing programmes. Attendance is used as a primary measure of engagement and outcomes tend to focus on the identification of logistical or programme factors as causes of non-attendance. There is also an absence of a theoretical framework for parental engagement. This research project addresses these areas by considering the wider ways in which parents may engage in obesity prevention. For example, this may simply mean that a parent acknowledges their infant as overweight or at future risk of obesity, thereby engaging in the idea that infant overweight is possible. This may then result in looking for more information or support from a health professional or implementation of

their own prevention strategies. The project sought to identify factors that may influence engagement within these early stages of behaviour change. An understanding of the barriers to engagement means that, where possible, they can be minimised or removed. Quantitative measures of parental engagement in obesity prevention are currently absent from the literature. This research addresses this gap and develops a new instrument based upon qualitative findings, literature and theory. The instrument measures barriers to parental engagement in the prevention of obesity during infancy. The new scale will help to improve knowledge of barriers to engagement amongst health professionals. It will also enable identification of those parents for whom the barriers are present, so that appropriate support can be provided.

2.11 Study Aim and Objectives

The aim of this research is to explore parents' beliefs on infant overweight and obesity risk assessment during infancy, to inform the development of a new scale to assess parental engagement in the early prevention of childhood obesity.

- To investigate parental beliefs and attitudes that might interfere with communicating about infant overweight qualitatively explore parents' beliefs about infant overweight and receptiveness to obesity risk assessment and subsequent behaviour change during infancy.

- To utilise qualitative findings, existing research, and theory to identify factors that may influence parental engagement in obesity prevention during infancy.

- To develop a psychometric scale to assess barriers to parental engagement, the Parental Engagement in Obesity Prevention (PEOP) Scale.

Chapter Three
Methodology

3.1 Introduction

This chapter presents the methodological approaches employed in this two-phase mixed methods study. The chapter begins by exploring the conceptual models of parental engagement before presenting the health belief model as the conceptual framework for this research project. The chapter presents a rationale for the choice of this model and discusses the existing research that supports the use of the theory. The second part of the chapter presents the philosophical assumptions that underpin the mixed methods approach chosen for the research. The chapter concludes with details and the rationale for use of an exploratory sequential mixed methods study design.

3.2 Parental Engagement – Models and Theory

In recent years there has been an increase in the development of conceptual models of parental engagement. Some models are unique to their discipline (Hornby and Lafaele, 2011; Samra, et al. 2015;) and some provide an overarching framework for engaging parents in prevention, whether that be health or education (Randolph, Fincham and Radey, 2009). In many cases, adult models of engagement (Hibbard, et al. 2004; Carman, et al. 2013) have informed those developed for parental engagement.

Most of the existing models of engagement are underpinned by three theories: the Health Belief Model (HBM) (Becker 1974; Rosenstock, Strecher and Becker, 1988); the Theory of Reasoned Action (TRA)/Theory of Planned Behaviour (TPB) (Ajzen and Fishbein 1975; Ajzen, 1991); and the family systems theory (Minuchin 1974; Randolph, Fincham and Radey, 2009).

Family systems theory (Minuchin 1974) considers ‘a family’ to be a system of interdependent individuals and that the behaviour of one individual will have an impact upon other family members. The theory includes factors such as family organisation, support, communication, attachment and cohesion. Literature to support the theory is lacking but it is suggested that parents’ propensity to engage in prevention may be influenced by the above factors (Kitzmann, Dalton and Buscemi, 2008). Other research suggests that parent-child attachment is the main factor related to engagement (Bauman, et al. 2001).

The HBM (Becker 1974; Rosenstock, Strecher and Becker, 1988) is currently the most widely utilised model and is the model with the most empirical research to support its use (Randolph, Fincham and Radey, 2009). The HBM advocates that perceived susceptibility and severity, defined as 'an individuals' subjective perception of risk to developing a disease' is an essential requisite in predicting if a person will adopt healthy behaviours to reduce that risk (Rosenstock 1974). Other constructs of the model include the barriers and benefits to taking action, which acknowledge that individuals must perceive the benefits of change to outweigh the costs. The construct of self-efficacy defined as 'one's confidence in his or her ability to engage in the target behaviour under a range of difficult situations' (Bandura 1977), was not included within the HBM until 1988 (Becker 1988). This was due to the origins of the model which sought to explain individual consent to screening or immunisation, then viewed as a simplistic cognitive process, so that self-efficacy was not considered as relevant. Self-efficacy is now recognised as a strong predictor of the uptake and maintenance of health behaviours (Badura 1977).

The TRA differs from the HBM in that it asserts that the most important determinant of behaviour change is behavioural intention which is determined by subjective norms and attitudes associated with the behaviour. The updated model, the Theory of Planned Behaviour (TPB) (Ajzen 1991), includes perceived control as a third determinant and is now recognised as one of the most significant predictors of both behavioural intention and behaviour (Godin and Kok, 1996). In relation to parental engagement, the intention construct of the TRA/TPB is the one most studied and findings suggest that parental intentions to enrol in a prevention programme are strongly related to their participation (McCurdy, et al. 2006; Dumas, Nissley-Tsiopinis and Moreland, et al. 2007).

3.3 Conceptual Framework

Given that the HBM is the most widely used and supported theory of engagement (Randolph, Fincham and Radey, 2009), although not a perfect fit, it is the one chosen as the most appropriate framework for this thesis. The HBM also has good predictive ability (Sheeran and Abraham, 2005) and is applicable to many different health behaviours.

In accordance with the HBM, perceived susceptibility to overweight or obesity and a perception of severity culminates in the perception of risk, an essential requisite in predicting behaviour change (Rosenstock 1974). The current literature exploring parents' perceptions of overweight during infancy is limited and inconclusive, some suggesting that parents do perceive it is possible for an infant to be overweight (Dinkel,

et al. 2017) and others who don't (Lakshman, et al. 2012). Parental beliefs around susceptibility to overweight and obesity do however appear to be influenced by infant feeding method, with a strong belief that breastfed babies cannot be overweight (Lakshman, et al. 2012; Dinkel, et al. 2017). Research examining parents' perceptions of an infant's susceptibility to developing overweight or obesity later in childhood, and the acceptability of the Proactive Assessment of Obesity Risk during infancy (ProAsk) (Redsell, et al. 2017) also indicated that parents perceived breastfed babies to be protected from overfeeding, excess weight and future risk of obesity (Rose, et al. 2019). In addition, parents of infants often do not perceive weight as a problem until after infancy, due to beliefs that they will grow out of it (McGarvey, et al. 2006; Kaufman and Karpati, 2007; Redsell, et al. 2010). A poor perception of the consequences and severity of childhood obesity may also negatively influence behaviour change and is suggested as a barrier to engagement (Park, et al. 2013). Current qualitative research also suggests that parents do not associate infant overweight with health risks and instead perceive underweight in infancy to be more problematic for health (Lakshman, et al. 2012). Research examining parents' views in relation to obesity risk assessment during infancy, also noted that parents of infants did not raise concerns regarding the health risks of obesity (Redsell, et al. 2010). In accordance with the HBM strategies that improve parents' perceptions of susceptibility to childhood obesity, such as risk assessment during infancy, may potentially help to enhance engagement in prevention.

Perceiving that there is a benefit to change also positively influences an individual's decision to engage in healthy behaviours, particularly if benefits outweigh the perceived barriers (Becker 1974; Rosenstock, Strecher and Becker 1988). Within the engagement literature, there is evidence to support this theory, with parents of children under five more likely to participate in prevention programmes if they can identify a benefit to themselves and their children (McCurdy, et al. 2006). Parents' perceptions of the benefits and barriers to acting early to prevent obesity and risk assessment during infancy, need further exploration. However, existing literature suggests that parents of infants have a preference for a bigger baby (Laraway, et al. 2010; Redsell, et al. 2010; Harrison, et al. 2017; moreover, the perceptions that weight is a safety net (Kaufman and Karpati, 2007) and having a heavier infant is a sign of good parenting (Higgins 2000) present barriers to change. Parents have also articulated that the provision of formula milk reduced anxiety about unexplained crying and is also associated with infant contentment (Redsell, et al. 2010), which may present as barriers to interventions aimed at modifying infant feeding practices to prevent obesity.

Parent's perceptions of the benefits of and drivers to engage within a group-based obesity prevention programme were recently explored by Love and colleagues (Love, et al. 2018). Parents of infants articulated the need for knowledge, affirmation and social connections as beneficial reasons to attend. Increasing awareness of the benefits of engaging in early preventive intervention is again a strategy for improving engagement.

Self-efficacy is known to be strongly predictive of the uptake and maintenance of health behaviour (Badura 1986) and parenting self-efficacy has been strongly associated with parenting competence and child developmental outcomes (Jones & Prinz 2005; Gilmore 2009). Self-efficacy is also recognised as an important concept within models of parental engagement (Samra, et al. 2015; Piotrowska, et al. 2016). empirical literature on the influence of self-efficacy upon and parental engagement is limited however infant feeding studies suggest that maternal self-efficacy is a predictor of engagement in breastfeeding (Blyth, et al. 2002; McCarter-Spauling and Gore 2009). A recent qualitative study by Love and colleagues (2018) explored the role of self-efficacy upon engagement (defined as attendance) in an obesity prevention programme for mothers of infants (Campbell, et al. 2008). Conversely, the study suggested that as self-efficacy increased, programme attendance reduced. This was believed to be due to a growing confidence and knowledge of parenthood as the infant got older a reduced need for support (Love, et al. 2018).

Although the HBM has been adopted as the most appropriate theoretical basis for this thesis, the assumptions of this model should be acknowledged. The HBM purports that for an individual to perceive risk, there needs to be a cue to action. In relation to this thesis, the cue to action would be the communication of information about an infant's risk status to a parent. However, this does not consider the step preceding this point and assumes that all parents will be receptive and have the desire for knowledge about their infant's risk status. As discussed within Chapter two, the limited existing literature exploring parents' views on obesity risk assessment indicates that there is a level of parental uncertainty about identifying obesity risk during infancy (Redsell, et al. 2010). In view of this, it cannot be assumed that all parents will consent or be receptive to receive information about their infant's risk status and that increasing awareness of the availability of obesity risk assessment tools for use during infancy with parents, will itself act as a cue to action. A second assumption of the model is the linear relationship between receiving personalised risk information and perception of risk. However, an individuals' perception of risk may be inversely affected by cognitive ability to understand information, particularly numerical information such as percentages and probability (Schwartzt, et al. 1997). Poor understanding has also been demonstrated to

influence how believable the information is seen to be and patients who do not fully understand what they see may not find the information credible or persuasive (Parrott, et al. 2005). Therefore, for the purposes of this research, it is assumed that risk communication is delivered effectively, and risk information is understood.

Parental engagement is a complex process and one influenced by several factors yet to be fully determined. Nonetheless, preliminary evidence from parenting prevention programmes suggests that engagement enhancement strategies modelled on theories, such as the Health Belief Model and Theory of Planned Behaviour, may increase engagement (Finan, et al. 2018).

3.4 Philosophical Assumptions

Research approaches are located within broader, abstract frameworks of philosophical assumptions about the natural world, known as ontology and epistemology. These philosophies seek to explain the nature of reality (ontology), and how we know what we know (epistemology). These basic set of philosophical beliefs and values, termed paradigms or worldviews, guide research inquiry (Guba and Lincoln, 2005). They underpin the way in which a researcher conducts research, in turn informing the methodology and methods. The perceived importance of the opposing assumptions underpinning quantitative or qualitative approaches to inquiry have been long debated (Creswell and Plano Clark, 2017). Quantitative researchers generally assume a post positivist position whilst qualitative researchers favour the opposing position of interpretivists, otherwise known as constructivist, naturalistic or hermeneutic (Denzin and Lincoln, 2011).

For this study, a mixed method approach is adopted. Mixed methods research has been termed the third methodological movement (Teddlie and Tashakkori, 2003) or “third research paradigm” (Johnson and Onwuegbuzie, 2004). Recognition of mixed methods research has been hindered by the traditional dominance of biomedical models of research; however, it is now recognised as a valid form of research in its own right (McAuley, et al. 2006) and is defined by Johnson, Onwuegbuzie and Turner (2007, p.123) as:

> *“The type of research in which a researcher or team of researchers combines elements of qualitative and quantitative research (e.g. use of qualitative and quantitative viewpoints, data collection, analysis, inference techniques)*

approaches for the broad purposes of breadth and depth of understanding and corroboration".

Despite acknowledgement of mixed methods as a third research method, a lack of consensus regarding its philosophical foundations exists between prominent researchers (Creswell and Plano Clark, 2011). Some, known as purists, believe that the two research paradigms are diametrically opposed, and therefore cannot be utilised together. This incompatibility theory (Howe 1988) has had significant implications for determining an appropriate philosophical partner for mixed methods research (Johnson and Gray, 2010). Some theorists suggest that pragmatism provides a solution and is the best paradigmatic partner for mixed methods research. Pragmatists believe that the research question is more important than either the data collection methods or the underlying philosophy (Mertens and McLaughlin, 2004) and it is therefore possible to integrate qualitative and quantitative within a single study if this provides the most appropriate way to answer the research question (Teddlie and Tashakkori, 2009). Others criticise pragmatism due to its over-simplification and focus on action over philosophy, and not all those that subscribe to the combined use of qualitative and quantitative approaches accept pragmatism as the solution (Johnston and Onwuegbuzie, 2004).

Instead, some advocate a mixed viewpoint approach (Johnston, Onwuegbuzie and Turner, 2007., Creswell and Plano Clark, 2011) which is the one utilised for this mixed methods study. This approach assumes multiple paradigms, recognising the assumptions of both as equally important. Each relates to the relevant phase of the mixed methods research design but given their differences, remain distinct and are implemented separately. This has been termed the complementary strengths stance (Hunter and Brewer, 2003; Morse, 2003). This study will assume an interpretivist position for the qualitative phase, followed by a post positivist position for the quantitative research (Creswell, et al. 2007; Creswell and Plano Clark, 2011).

For phase one of this research, an interpretivist position was assumed. Inquiry from this standpoint recognises multiple realities (relativist ontology), embraces subjectivity and favours inductive reasoning (Creswell, 1999). Ontologically, this study views the world as having multiple realities. Reality is taken as being socially constructed, seeks to understand the different and varied thoughts of individuals and appreciates that this is influenced by a number of social factors (Willig and Stainton-Rogers, 2008). Given the ontological perspectives, it follows that epistemologically, the researcher values the

importance of subjectivity and recognises that regardless of the quality of research techniques, employed bias is unavoidable, as we are unable to study human subjects completely objectively. Reflexivity, the researcher's role, and their influence on context and relationships throughout the research, is also appreciated and it is acknowledged that findings of the research are co-constructed and influenced by both the researcher and participant's experiences (Roulston, et al. 2008). For this phase, an inductive approach to reasoning is used in order to identify a theory of pattern within the data (Creswell, et al. 2003). Qualitative research is broadly characterised by the process of analytical induction and involves the researcher moving from observation to generalisation, i.e. inferences are made from specific observations to more general rules in order to construct a hypothesis or theory (Draper, 2004). The inductive approach used for this study sought to explore the complexity of views rather than narrowing a meaning to a few ideas and did not attempt to fit the findings into pre-existing coding frameworks or previous theory but instead was driven by the data itself. The philosophical assumptions and underpinning each phase of the research strategy employed are summarised within Table 2.

Table 2 Philosophical assumptions

Paradigm	**Ontological Beliefs (nature of reality)**	**Epistemological Beliefs (How reality in known)**	**Axiological Beliefs (role of values)**
Study 1 Interpretivist	Relativism. Reality is subjective	Subjective, researcher may not be independent from that being researched	Inquiry is value-bound
Study 2 Positivist	Reality is objective and singular	Objective, researcher is independent from that being researched	Value-free, unbiased

Source: Adapted from Lincoln et al. (2011)

Phase two reverted to a post positivist research paradigm. Research that seeks to explain relationships and attempt to identify causes that influence outcomes, are situated within this paradigm and seek to understand causal relationships; thus, experimentation and correlational studies are used (Creswell, 2009, p.7). This scientific paradigm seeks predictions and generalisations; thus, methods often generate quantitative data such as a closed ending questionnaire, as in this case (Pring, 2000a, p. 34). Ontologically, in this phase of the study, the position is one of realism, thereby a view is held that objects have an existence independent of the knower (Cohen, et al., 2007, p.7). In other words, a discoverable reality exists independently of the researcher

(Pring, 2000a, p. 59). In relation to epistemology, research from this position is seen as objective; therefore, the researcher and the researched are independent (Crotty, 1998, p. 8). This phase of the research utilised the opposing style of reasoning, deductive reasoning (Creswell, et al. 2003).

3.5 Study Design

There is a plethora of available mixed method study designs and typologies (Greene, et al. 1989: Plano Clark and Ivankova, 2016, Creswell and Plano Clark, 2017). Given this choice, an understanding of the key dimensions underpinning these designs is important when choosing and rationalising one for a specific study. There are a range of dimensions that underpin even the most basic of mixed method designs, some with overlapping dimensions and some distinct within particular typologies (Tashakkori and Teddlie, 2010; Teddlie and Tashakkori, 2009). Greene usefully summarises these seven dimensions (Table 3) as either primary, which are those cited within nearly all design frameworks, and secondary, those that only appear in some (Greene, 2008).

Table 3 Seven Dimensions of Mixed Method Designs (Greene 2008)

Primary Dimensions	
Independence/Interaction	The degree, to which different methods are conceptualised, designed and implemented independently or interactively when mixing happens e.g. at the end or through the inquiry.
Status (parity, dominance)	The priority of dominance given to one methodology over another versus equity of methodologies
Timing	Whether the different methods are implemented concurrently or in a sequence
Secondary Dimensions	
Transformative intent	Presence or not of an explicit action or political agenda in the enquiry
Study	Whether the mixing happens within one study or across coordinated studies in a programme of research
Strands/phases	Number of different strands that are mixed in a study
Method characteristics	The character and extent of the setting differences (in bias, perspective, stance) in methods being mixed

Source: Adapted from Creswell and Plano Clarke (2011)

The objectives of this research were achieved using a two-phase mixed methods study using an exploratory sequential design (Creswell and Plano Clark 2011) (Figure 1).

Figure 1 Exploratory Sequential design

The rationale for the use of this design was the development of a new quantitative data collection instrument (Bryman 2006, Onweuegbuzie, Bustamante and Nelson, 2010); when being utilised for instrument development as in this case, the design is also referred to as the instrument development design (Creswell, Fetters and Ivankova, 2004). Dimensions relevant to the exploratory sequential design include: determination of the level of interaction between the quantitative and qualitative strands of the study (i.e. Independent or Interactive); priority given to the quantitative and qualitative strands of the study, timing or implementation of each strand of the study; and where and how the strands are integrated within the study. Details of how these are approached within this study are discussed in more detail below.

As the name of the design suggests, qualitative and quantitative methods are implemented sequentially. The intended sequence for this study was a qualitative strand of inquiry followed by a quantitative strand. Qualitative data was analysed fully prior to starting of the second quantitative phase of the study, so that methods would be implemented independently as two distinct phases. The rationale for choosing this mixed methods study design is so that the inductive qualitative inquiry could inform and underpin the development of a new quantitative data collection instrument (Bryman 2006, Onwuegbuzie, Bustamante, and Nelson, 2010), The Parental Engagement in Obesity Prevention (PEOP) scale. Given the limited existing literature on parents' perception of infant weight and obesity risk communication an exploratory qualitative phase of research was imperative to inform the second quantitative phase in which a scale would be developed. In such a design it is considered that the initial qualitative phase, or proportion of the research, is 'self- sufficient' and able to stand alone (Morgan, 2015). The chosen design is complementarity, so seeks to utilise the strengths of qualitative methods in order to enhance or improve the performance of the quantitative phase of the research (Morgan, 1998).

This was chosen in light of the lack of existing research in this field and for an in depth, understanding of unknown areas of research, prior to the design of a quantitative tool, as without such qualitative research, the identification of salient constructs for measurement would not have been possible. Morgan (2015) importantly highlights the common misconceptions of these designs, stipulating that the purpose of following up qualitative research with quantitative is not to correct or compensate for its weaknesses, or indeed to verify and validate qualitative results, thereby undermining the value of qualitative methods, but to add additional strength to the research (Morgan, 2015).

Integration within mixed methods studies can enhance its value (Bryman, 2006; Creswell, 2011). It is conceptualised to occur through the linking of methods of data collection and analysis (Creswell, 2011). Integration is thought to occur at three main points in a study, the design, methods and interpretation (Fetters, Curry and Creswell, 2013). For this research, integration was incorporated within the study design through the use of the exploratory sequential design in which the initial data collection and analysis of qualitative data informed subsequent quantitative data collection (Onwuegbuzie, Bustamante, and Nelson, 2010). Within the methods, integration occurred through “building” and results from the qualitative data analysis informed the data quantitative data collection, the latter building on the former. Salient constructs for measurement within the scale and subsequent data collection are developed from the qualitative research findings. Integration at the interpretation or reporting level phase of this research was via a narrative approach (Fetters, Curry and Creswell, 2013). A narrative approach enables the researcher to present the qualitative and quantitative findings in a single or series of reports in which a narrative approach can be weaved, contiguous or staged. For this study, a contiguous approach was utilised, so findings are presented within a single report, but the qualitative and quantitative findings are reported in different sections (Fetters, Curry and Creswell, 2013).

Chapter Four: Study One

A qualitative exploration of parents' beliefs surrounding infant overweight and the identification of the future obesity risk during infancy.

4.1 Introduction

This chapter describes the initial stage of this two-phase mixed methods research project. Study one, uses qualitative research methods to explore parents' perceptions of infant overweight and receptiveness to obesity risk assessment during infancy. The findings of this study are published in a peer-reviewed journal (Bentley, et al. 2017).

As discussed in Chapter two, the current research on parents' perceptions of obesity risk assessment during infancy is extremely limited and is an area that requires further investigation (Redsell, et al. 2010, Rudolf, 2011, Canfell, et al. 2018). The existing research, albeit limited, suggests there may be a number of factors that may influence parents' receptiveness to risk assessment and subsequent behaviour change during infancy. Such barriers include fear of judgement, shame and stigma, and preference for a bigger baby (Redsell, et al. 2010). Other mothers have expressed concerns about being labelled as inadequate parents or becoming paranoid about what they feed their baby (Rudolf 2011). If such barriers are not recognised and addressed, in line with theoretical models of behaviour change the perception of risk will not be realised and behaviour change may not result. Literature exploring the factors influencing parental engagement in obesity prevention is lacking and apart from the study by Love and colleagues (Love, et al. 2018), to date there are no high quality qualitative studies researching the possible barriers or facilitators to parental engagement. Parental engagement also lacks a sound conceptual and theoretical framework and quantitative measures of parental engagement are also absent. It is clear that more research needs to be undertaken to improve our understanding of parent's perceptions, and it is crucial to unravel factors that may negatively influence parental engagement in the early prevention of obesity. Given the lack of literature on obesity risk assessment, parental engagement in obesity as well as the absence of existing quantitative measures, further exploration is required in order to understand the salient constructs of parental engagement to inform the development of the new PEOP scale.

The aim of study one is to: qualitatively explore parents' beliefs about infant overweight and assessment of their infant's risk of developing future overweight or obesity in order

to identify factors that may influence parental engagement to risk assessment and behaviour change.

- Provide an in depth understanding of parents' beliefs about the causes of and solutions to excessive early weight gain infancy, and their perceived responsibilities and role in prevention.
- Explore parents' receptiveness to obesity risk assessment and communication of risk from a health professional.
- Identify factors that may influence parental engagement in obesity risk assessment during infancy and subsequent behaviour change that supports the prevention of childhood obesity.

4.2 Study Procedures

4.2.1 Sample

The study sample were parents and guardians of infants 12 months of age or younger living in Cambridgeshire. Purposive sampling was used to recruit participants who were attending existing mother and baby groups or weighing clinics at Children's Centres. The three Children's Centres selected as sites for recruitment were chosen due to their geographical within areas of higher obesity prevalence. Obesity prevalence rates amongst children in reception year (age 4-5 years) was used to identify areas that were higher when compared to Cambridgeshire as a county using data from the National Child Measurement Programme data (NCMP). It is appreciated that parents of infants at an increased risk of future childhood obesity development are the most appropriate study participants. However, despite the existence of overweight risk tools (Weng, et al. 2013), without adequate understanding of their use in clinical practice and resources to support intervention when risk of overweight is identified, the use of such tools to screen parents for inclusion in this study, was seen as unethical.

4.2.2 Sample Size

Twenty participants took part in the study, nineteen women and one man. This sample size was determined as the point at which saturation was reached and that to continue interviewing would have no further benefit to the depth and diversity of the data collection (Guest, Bunce and Johnson, 2006).

4.2.3 Recruitment

Participants were recruited from Cambridgeshire County Council Sure Start Children's Centres during May 2014. Children's Centres improve outcomes for young children, five

years and under and their families and provide support and intervention focusing on families most in need, preparing children for school, supporting parents, and providing healthcare. From the forty centres across Cambridgeshire, those targeted were geographically situated within the most socially deprived wards of the county. Initial contact with the centres was made via email and telephone in February 2014. Following an expression of interest, the centres were sent a letter with details of the study and ethical considerations and asked to provide their signature as written confirmation of their commitment to be involved (Appendix A). All four centres targeted for involvement responded positively; however, only three did so within time for Anglia Ruskin's ethics application (see section 4.7). To recruit participants, the researcher attended staff meetings at each of the three centres, where the research project was explained, and any questions or concerns discussed. Staff provided information to the researcher about existing groups or clinics with mothers of infants aged one year who would be suitable for the study. Posters and participant information sheets were displayed by centre staff, so they were able to recruit and signpost mothers to the study (Appendix B and C). Existing groups and baby weighing clinics were attended and parents were briefed about the study and approached to be involved. Briefing took place as a group; the researcher spoke individually to parents as necessary and answered questions. Details of groups attended and recruited participants are provided in Table 4.

Table 4 Children's centre groups

Children's Centre	Group/Event	Date/s Attended (2014)
Centre 1	Mother and baby group	27.5.14
	Parent led baby group	27.5.14
Centre 2	Social babies' group	25.6.14,16.7.14,23.7.14,8.10.14
Centre 3	Baby weighting clinic	29.7.14

Participant involvement in the research was on a voluntary basis. At each of the group sessions, parents were provided with a thorough verbal and written description of the research and provided with the opportunity to ask questions and allay any concerns prior to consenting. Parents who wished to participate provided written consent (Appendix D), along with their contact details, to the researcher and a mutually convenient time and place (either at their home or at the Children's Centre) for the interview was arranged.

4.2.4 Exclusion Criteria

Participants unable to understand spoken English were excluded from the study. Guidance about a parent's ability to understand English proficiently enough to take part in the study was taken from children's centre staff.

4.3 Measures

4.3.1 Demographic Questionnaire

Each participant completed a structured demographic questionnaire that included items about both the mother and their infant. This included gender, age, ethnicity, education level, current employment status, postcode, and maternal smoking status. Information collected about the infant included age, gender and birth weight and infant feeding method. Participants were also asked to self-report their current height and weight so that body mass index (BMI) could be calculated.

4.3.2 Semi-structured Interview

A semi-structured topic guide was developed (Table 5) to guide the researcher. Topics for discussion were informed by the existing research, (Redsell, et al 2010), and developed in collaboration with the supervision team. The topic guide was initially pilot tested face to face with a small number (four) of volunteer friends and family that were parents of infants. This led to small revisions to the guide considered beneficial to stimulating conversation. The guide acted as a prompt during interviewing; however, it evolved throughout the interviews to enable and encourage discussion and topics were not necessarily discussed in order.

4.4 Data collection

4.4.1 Interview process

To explore the multiple and subjective views of study participants, an inductive and emergent design using semi- structured interviewing techniques was employed. Interviews were conducted face to face and individually. Participants were offered a choice of venue where they would prefer the interview to take place, either in a private space at the children's centre or within their home. This was to enable them to feel comfortable and overcome any logistical issues in terms of parental commitments. Participants were encouraged to express their own views and to lead the discussion in other directions, provided it was relevant to the research topic. This was through the use of open questions. Probing was used to clarify participant answers and to request further information (Rubin and Rubin, 1995).

Probing questions included requests for extension of the conversation such as ‘Can you tell me more about……?’ and responses to encourage further conversation such as ‘Uh huh?’, ‘Yes?’ Additional notes, observation and reflections about the interview process and topic were taken immediately after each interview.

Table 5 Interview topic guide

Please tell me about your baby’s growth since birth, have you ever had any concerns or worries about their growth? Do you think you would be concerned if you thought your baby was gaining weight too quickly? What do you think could be some of the reasons why a baby might gain excess weight? [Expand by asking why these factors, how important factors are in relation to each other] Discussion and opinion about other reasons How much control do you think a parent has over their baby’s weight? Are you aware of any other factors that you think may be important and related to a child becoming overweight?
To explore parents’ perceptions on the solutions to, and prevention of, overweight in infancy.
What do you think could be done to help an infant from gaining weight too quickly? Who needs to be involved in helping to prevent children becoming overweight/to help children remain a healthy weight? Whose responsibility do you think it is to intervene? How much control do you think parents have in preventing children from becoming too large/big, when they are a baby? Have you ever felt or have known other parents that have felt blamed when their babies/children become overweight? Where does the blame come from?
To explore parents’ beliefs on the benefits, harms of and emotional response to the idea of an intervention in which the future risk of their infant developing childhood obesity is identified and communicated.
If a Dr/Health Visitor was able to assess a baby’s future risk of becoming an overweight child, do you think they should do this? Who should they tell/why? What should they say? How would it be best explained? As a parent, what might be the benefits of knowing this information? What concerns do you think you might have as a parent? What support do you think you would like, or need having been told about this?

4.5 Ethical considerations during interviews

Potential risks to psychological well-being, mental health, personal values, and dignity were considered, and sensitivity and caution applied to reduce any potential negative impact of the interview process. In the event of any expressions of anxiety from parents about their child's feeding or growth, a referral to the Children's Centre or health visiting staff was actioned. For interviews taking place at the Children's centres, confidentially was maintained through, the use of a separate private room provided by the centre. When conducting interviews in participants' homes, safety procedures and actions to minimise the level of risk to both the researcher and participant were assessed using an Anglia Ruskin University (ARU) risk assessment form. Assessment of risk included those associated with lone working. Risks to the researcher were reduced through telephone or text contact with a member of the supervisory team with details of the study participant's address prior to entering the participant's home, contact was then made again after the visit to ensure the researchers' safety.

4.6 Data Analysis

4.6.1 Demographic questionnaire

Questionnaire data was entered into SPSS (Version 20). Summary and descriptive statistics were calculated for the demographic, personal and professional details.

4.6.2 Interviews

Interviews were audio recorded, downloaded and played back and transcribed verbatim. To improve familiarity with the data, manual transcription was performed. QSR NVIVO Version 10 was used to code the data (QSR International). Illustrated examples of coding either by node of participant are available upon request. Inductive approaches to data analysis were employed to build patterns, categories, and themes from the "bottom up" organising data inductively (Hsieh and Shannon, 2005). An inductive approach to analysis used codes derived directly from the transcribed text and then a thematic approach to analysis was applied in order to identify, analyse and report themes within the interview data (Braun and Clarke, 2006). A six phased approach (Table 6) to data analysis was used to guide the analysis of the interview data (Braun and Clarke, 2006).

4.6.3 Quality assurance

Two members of the PhD supervisory team (RC and SR) checked the internal reliability of the data. Assessing internal reliability involves analyses to check that the primary researcher's assignment of codes and identification of themes from the data would be replicable by a different observer. Two members of the research supervisory team

therefore coded independently, and the application of concepts was compared, and adjustments made as appropriate (Thomas and Harden, 2008).

Table 6 Phases of thematic analysis

Phase	Description of process
1. Familiarisation with the date	Transcription of data, reading and re-reading of data and noting of initial ideas
2. Generation of initial codes/nodes	Coding interesting features of the data in a systematic fashion across the entire data set. Collation of data relevant to each code/node
3. Search for themes	Collating codes into potential themes and gathering data relevant to themes
4. Review themes	Check if themes work in relation to coded extracts (Level 1) and the entire data set (Level 2). Generation of a thematic map of the analysis
5. Defining and naming the themes	On-going analysis to refine the specifics of each theme and overall story of the analysis followed by generation of clear definitions and names for each of the themes.
6. Report production	Selection of vivid and compelling extract examples, final analysis of selected extracts, relating analysis back to research question and literature followed by production of final report.

Source: Adapted from Braun and Clark 2006, p.87.

4.7 Research Ethics and Governance

The researcher has been mindful of the ethical requirements set out by the university and the other organisations involved. Ethical standards set by the university within the published Research Student Handbook (ARU 2010a) and the Research Degree Regulations, were adhered to and ARU online ethics training was also undertaken. The study was conducted in accordance with the ethical principles that have their origin in the Declaration of Helsinki, (World Medical Association 1996); the principles of Good Clinical Practice (Medical Research Council 1998), and the Department of Health Research Governance Framework for Health and Social care, (2005). Application for ethical approval was sought and received from: Anglia Ruskin, (Faculty of Health Social Care and Education), Departmental Research Ethics Panel (DREP) for Primary and Public Health Department (PPH/DREP/14-002) 19/3/14. (Appendix E). Cambridge

County Council, RGF Approval Panel. Approval from Cambridgeshire County Council was also sought and confirmation that the study met the Council Research Governance Framework was obtained from the Directorate of Children, Families and Adult Services in April 2014.

The application included the research protocol, informed consent forms and parent information sheets. Information about the right to withdraw at any point of the process was discussed and parents were left with a tear-off slip enabling them to contact the researcher and withdraw at any time. It was explained that those wishing not to take part or wishing to withdraw from the study would be respected and prior to the analysis of data their participant data destroyed and that their rights to care would not be affected. Several processes were followed to ensure the privacy of individuals was protected. This included applying identify codes to all written information and data collected to protect anonymity. Given the potentially sensitive nature of the research topic of childhood obesity risk, the four principles of the British Psychological Society (BPS) were carefully considered. These include respect for autonomy and dignity, scientific value, social responsibility and maximising benefit and minimising harm (BPS 2009).

4.8 Results

4.8.1 Participant Information

Seven recruitment visits were made to Children Centre groups from which a total of 44 parents were approached Of these, 36 consented and 20 went on to be interviewed (both parents were present at three of the interviews, due to them attending clinic with their partner, however, all interviews were conducted with just one parent) (Table 2). Reasons for non-response following initial interest included no answer to calls/no response to voice mail messages or wrong number provided by participants (n=7), withdrawal due to family bereavement (n=1), lack of time (n=1), feeling uncomfortable about the subject matter (n=1), or no reason stated (n=3), and the baby was > 12 months (n=1). One interview was excluded due to an incomplete audio-recording. Twelve interviews took place at a Children's Centre and eight in the participants' homes.

4.8.2 Parent and Infant Characteristics

Responses to the demographic questions answered by the mothers about themselves and their infant are summarised in Table 7. A total of 20 parents participated, the majority of whom were female. All were white, the majority employed (75%) and non-smokers (65%).

Table 7 Parent and infant characteristics (Study One)

Parent Characteristics n=20	
Age in years (%)	
20-29yrs	11
30-39yrs	9
Gender	
Female	19
Male	1
Ethnicity	
White	
English/Welsh/Scottish/Northern Irish/British	18
Any other White background	2
Employment Status	
Unemployed	5
Employed	14
Self-employed	1
Smoking Status	
Smoker	7
Non smoker	13
Body Mass Index (BMI)	
< 18.5 (Underweight)	1
18.5 – 24.9 (Healthy Weight)	7
25 – 29.9 (Overweight)	7
30 – 39.9 (Obese)	3
40> (Morbidly Obese)	1
Missing data	1
Level of education	
GCSEs	3
NVQs	2
A Level	3
Diploma	7
Degree	3
Higher Degree	2
Infant Characteristics	
Age	
Newborn – 12 weeks	1

3 - 6 months	13
7 – 9 months	3
10 – 12 months	3
Gender	
Male	10
Female	10
Birth Weight	
< 2.93kg	4
2.93 to < 3.24kg	5
3.24 to < 3.49kg	2
3.49kg to < 3.81kg	5
> 3.81kg	4
Infant ever breastfed	
Yes	18
No	2

From the self-reported BMI data, fifty-eight percent were either overweight or obese in line with UK levels of female adult obesity (NHS Digital 2018); twenty-five percent were educated to a degree level or above. Most of the infants were between 3-6 months old and had been breastfed at some point, although information on the duration of breastfeeding was not collected. Birth weight ranged between 2.73kg and 4.76kg, fifteen percent were above 4kg, which is associated with a higher risk of obesity (Yu, et al. 2013).

4.8.3 Interviews

Three main themes and associated subthemes resulted from the interview data (Table 8)

Table 8 Themes and subthemes

Identification of infant overweight and future risk	**Consequences of infant overweight status**	**Parental attributions of causality, responsibility, and control**
1a) Overweight as a concept that can be applied to infants	2a) The relative impact of overweight versus underweight	3a) High parental responsibility for overfeeding

1b) Trust and mistrust of professional growth assessment	2b) The progressive nature of consequences associated with overweight	3b) Low parental self-efficacy for modifying infant feeding
1c) Receptiveness to risk communication and modification of lifestyle behaviours	2c) The importance of infant contentment	
1d) Perceived benefits and harms of risk communication	2d) Good parenting and the fear of negative judgement	

Theme 1: Identification of infant overweight and future risk

Subtheme 1a: Overweight as a concept that can be applied to infants

Participants readily accepted childhood obesity as a prevalent and significant issue within society and did not challenge the idea that a conversation around infant overweight was appropriate.

> *"… the future is looking fat, isn't it?"* (P10)

Parents replied with little hesitation that they would be able to recognise overweight or rapid growth in their baby, justifying this as a matter of common sense and utilising norm-referencing and comparison to peers.

> *"Well I think it is just a matter of common sense if they look really fat"* (P7)

> *"When I go to visit my friends and I saw two or three week old babies and they were smaller than mine (when he) was born just now it was oh he's a big boy. And now he is big too because now he's seven and half kilo around something, so it's really big because he is just three and a half months, like my friend have a girl and she is eight months and just eight kilos" (P20)*

Participants generally used socially constructed comparisons, to emphasise shape and form as descriptors, by making visual comparisons to siblings and peers, or being able to fit into clothing with an appropriate age-label.

> *"He's wearing one- to two-year-old clothes and he is not even one yet"* (P16)

> *"If they were growing too quickly it's obviously the simple ones like you know, out growing their clothes to early and like they are in 12-18 months and they are only three months old, that kind of thing which is really obvious".* (P4)

Without prompting some parents provided voluntarily admissions of their infants overweight, personalising the issue within general conversation.

> *"When he was born he was nine pounds, um he's always been quite big, quite tall as well, um he was on one of the higher centiles in his red book, um he's now off the scale. At 11 months he weighs 31 pounds and he's actually off the edge of the book now"* (P2)

Although not explicitly asked to (as per the interview schedule), some parents went on to describe their own infant as overweight using terms ranging from overweight and obese, to big, massive, and chubby, and also chunky monkey.

Subtheme 1b: Trust and mistrust of professional growth assessment

Despite the positive attitude to self-identification, parents demonstrated hesitation about the role of health professionals in identifying infants as overweight.

> *"The first responsibility it's with the parent but there should be some professional help …{to}…help parents recognise that the baby is becoming overweight"* (P18)

Partly this was because it was felt to be unnecessary, since they as parents could be relied upon to identify it, but also due to experience of, or concerns about, being judged.

> *"I don't think parents should need to be intervened because they should be able to see their child is obese…"* (P14)

> *"..You wouldn't be happy because you would feel like he was sectioned out from all the other babies … people would be saying oh that baby is fat, you wouldn't be very happy."* (P15)

> *"I don't know, I think the health visitors should mention it but I don't think they should make a big thing of it saying like you know making you feel like a bad parent, because obviously everybody is different some babies are going to gain weight quicker and some aren't"* (P15)

Parents were very aware of the growth charts and centiles used by health professionals, and referred to them as charts, the red book, or the line. However, accounts suggest some uncertainty about what the centile lines represent as well as widespread scepticism around the growth standards.

"In our baby's health book um and the lines go from 0.4% all the way through to, well I think it's through to 100% it might even be more than that and I'm guessing that your aiming for the 50th percentile on that um but nobody has ever really said anything about it…" (P1)

"But I think the line is pretty stupid anyway if I'm honest, because each child is individual, and they will grow as they want" (P14)

Notably, some participants described circumstances in which the growth standards did not apply to them.

"Because she was born so heavy, she didn't seem to work so well with the growth charts in the little red book" (P7).

Despite lack of enthusiasm for growth standards, parents frequently attended baby-weighing clinics – a process described as checking – and were reassured when their baby was on the line or following the line.

. "I mean I do look at him. Everyone looks at him and says god he's massive, he's not only six months and I say when you weigh him and put him on the chart he's not, he's bang in the middle (P12)"

"I was concerned obviously how small she was when she was first born but they said from day one that she's absolutely fine and because she's stayed on the line all the way through I have not been worried about it" (P11)

However, participants, particularly those whose babies were on the upper or lower centile lines, demonstrated an element of disbelief regarding their baby's growth despite reassurance from the health professional that their baby was following the centile line. Discourse suggests that what was being explained to them as normal and nothing to worry about was misaligned with their perception of their baby's weight from their physical appearance and again, how they looked in comparison to other infants of the same age.

"The health visitor always tells me she's perfect for the centile she's on; she's perfect for her so I've got to stop worrying about it really. But I look at the weight of other children and I'm like they weigh more, and the health visitor has to remind me that they are not on the same centile as she is" (P10)

"No, no he's in the middle; he's like on the fiftieth centile so although he looks a bit chubby he's normal apparently but yeah no, no problems" (P12)

Subtheme 1c: Receptiveness to risk communication and modification of lifestyle behaviours

Notably, the possibility of predicting future obesity risk was treated with pleasant surprise and elicited very little questioning from parents. There was an overwhelmingly positive desire to receive information about both their infants' current weight status, if it was a problem, and the future risk of their infant becoming overweight.

> *"…I would be happy for her to say it outright if that was a chance then so if she was to say that would be fine"* (P13)

> *"Well, I think you definitely need to have a conversation you need to know the facts; you need to know the risk factors and you need some advice about what to do"* (P1)

> *"Yeah definitely, definitely if there was something that could be done, or that I was doing wrong that I could do differently then, yeah I would want to know"* (P8)

Provision of information about overweight risk was viewed as more acceptable or 'believable' when provided once an infant is walking.

> *"Well, you have your two year check, so a two year check would probably be a good one because they are definitely walking then" (P12)*

Walking was associated with an increase in energy expenditure and viewed as an important point at which those children with puppy fat (which can be naturally grown out of), are separated from those who will have persistent overweight tracking through life. The degree of parental concern about infant overweight status was linked to an infant's stage of development. Participants repeatedly suggested that the point at which they would become concerned was when their infant remained overweight once walking.

> *"…my opinion is that when he starts walking about he'll burn it off and I'm quite an active person, I walk pretty much everywhere unless isn't in walking distance and so he will, it will come off him and he will be fine."* (P4)

> *"So, at this age I don't think, like he's six months so like up to a year I don't think it's an issue because they are not moving.* (P1)

Subtheme 1d: Perceived benefits and harms of risk communication

The primary benefit parents ascribed to knowing about their infant's future risk was because it acted as a cue to action, with some parents specifying possible behavioural strategies.

> *"Well at least then you could sort things out a lot quicker…"* (P2)

"I suppose if she started to become fat I'd probably think about the amount of calories we are giving her and giving her more vegetables and things that will give her nutrients…" (P7)

"..If I was told he was overweight I would probably be feed him fruit and making him go healthy" (P14)

However, the possibility of negative behavioural change was raised.

"It would worry me because some mums might panic that their child is going to become overweight as a baby and not feed them as much" (P17)

When questioned about how they might feel after receiving risk information, parents focused on negative feelings of self-blame such as; bad parent, and ashamed for not serving the best interests of their infant as well as upset, worried, annoyed, offended, and shocked. Interestingly, participants were not only concerned about feeling guilty for serving their child's best interests, but also by how this would be perceived (and judged negatively) by others. However, for parents in this study, the potential negative emotions although recognised did not supersede the desire for knowledge.

"… I said I'd feel ashamed, like you know, but I would rather be told I would rather know than not know" (P5)

"I would feel really bad I had let her get to that point rather than getting help and asking for help before it got too bad you know that would be my fault for letting her get that way" (P17)

Finally, the importance of a non-judgemental communication style to reduce negative emotions was identified.

"… not being so abrupt and like out right blaming the parents I think it needs to be done you know in a sensitive way because some parents will, aren't going to be happy with the fact that you know…" (P17)

Theme 2 – The consequences of infant overweight status

Subtheme 2a: The relative impact of overweight vs. underweight

Concerns about underweight or poor growth were evident and often regarded as more worrying than overweight. High levels of anxiety were articulated about poor infant growth or falling short of the line (see subtheme 1b), which were felt to be caused by the response of alarmist healthcare professionals.

"… they were like we have to get the weight on we have to get the weight on so I found it traumatic for at least the first two weeks" (P6)

*"It gave me a lot of unnecessary worry that they were saying that she wasn't putting on enough weight, when she was really alert, responding well, you know seemed to be doing fine but it just, the numbers didn't seem to add up, I mean she obviously wasn't a podgy baby but she didn't look too thin either. So that was I think, it could have been, I don't know it would have been nicer if they weren't so concerned about it" (*P7)

Subtheme 2b: The progressive nature of consequences associated with overweight

Overwhelmingly parents problematised infant and toddler overweight in terms of the likely continuation of excessive weight from infancy into both childhood- and adulthood.

"…I think it's a real concern, I mean you do not want an overweight child and the concern, I suppose the concern is that if you have an overweight baby they become an overweight child" (P1)

"...whereas toddlers I think if they get to that age and they are already chubby they are going to get chubbier and chubbier" (P12)

The immediate concerns relating to infant overweight were in relation to its impact initiation of walking and other developmental milestones.

"Just that she's going to get really obese and by the time she's a year old not be able to walk because she's going to be too fat to lift her own weight." (P19)

Intermediate concerns related to bullying at school and it was only in relation to adult overweight that health consequences, most notably diabetes and heart attacks, were referenced.

"I am not fussed at the moment, but when he starts going to nursery or starts going to school then I wouldn't want him to be overweight at that age." (P2)

*"I'll try to prevent illness, because I know that being overweight you've got a risk of so many like, so many things, arteries, heart attacks in the future and so I know the side effects of being overweight" (*P4)

Subtheme 2c: The importance of infant contentment

For some the goal of infant contentment over-rode concerns about overfeeding and overweight. Interestingly, participants most frequently discussed a baby's contentment in the context of regular, ample feeding, and maternal happiness was centred on infant happiness.

"Obviously I think he is pretty chubby, but I don't see a problem with it because he is happy so" (P15)

" As long as they look healthy and they are drinking their milk I'm not too fussed. I get worried if X don't drink all his bottles but as long as he's drinking and seems to be growing and he looks happy and healthy I'm happy with him." (P14)

Subtheme 2d: Good parenting and fear of negative judgement

Participants repeatedly voiced concerns about being judged as a bad parent by others for having an overweight child, and some reported experiences of this. When asked about whom they feared judgement from, other parents and people in the street were typical responses.

"As she gets older, and obviously whatever people are going to think about me as a parent for letting her get like it, if she's like ridiculously overweight or anything like that" (P11)

"I don't know really just like random people, if you're walking down the road or something you don't want someone to shout out, oi your baby's fat" (P15)

Societal stigma surrounding adult obesity was also apparent in parent narratives, particularly amongst participants who were themselves overweight.

"Yeah they think a fat girl with a fat baby" (P2)

Theme 3 – Parental attributions of causality, responsibility, and control.

Subtheme 3a: High parental responsibility for overfeeding –causal

When questioned about preventing the onset of excess weight gain during infancy all participants stated - without hesitation - that it was their responsibility as parents, and cited overfeeding as the main contributing factor.

"I have all of it, I have all the control at the end of the day I am the one, she is not feeding herself at the moment…" (P17)

"I have not really thought about weight I think it is, the only thing I think it really could be at the moment is overfeeding, feeding when it's not necessary" (P17)

Overfeeding was discussed primarily in relation to formula milk and solid foods and parents held the view that obesity was more common amongst formula fed babies as they described how breastfed babies could not be overweight or, if they were, that this was not unhealthy and would naturally resolve itself.

"If you're breastfed you can't, you can't overeat so if they are gaining weight that is their natural …" (P6)

"You know but then I am breastfeeding, so I am not worried about that too much" (P20)

The sense of responsibility for overfeeding translated into self-blame for parents describing their babies as overweight, which contrasts with the general ease of self-identification (subtheme 1a).

"...I do feel the blame is solely on yourselves because you're looking after um, you're the one that's giving them food and letting them eat it" (P5)

Subtheme 3b: Low parental self-efficacy for modifying infant feeding

Contrasting with the sense of parental responsibility, participants voiced a limited sense of control regarding weight-related behaviours.

" I suppose there is not much you can do about it if they are overweight when they are still young and they still want feeding" (P7).

When (voluntarily) disclosing that their baby was overweight, participants went on to comment upon their child's eating behaviours and openly acknowledged that their child had a big appetite or was a hungry baby.

"…so she was just, ate more and more and more, the more you offer the more she will have" (P19)

Although parents did not use terminology such as responsive feeding, they distinguished feeding cues and described using strategies such as distraction, the use of a dummy, and water to reduce the frequency of feeds. However, there was also a deep reluctance to implement any changes to their child's milk diet beyond what they perceived their infant needed, regardless of any effect on weight.

*"I don't know, because I don't know I suppose like if a baby is hungry then a baby is hungry and to sort of reduce their milk if they are still hungry that seems really cruel" (*P13)

Weaning was considered to be a more suitable window of opportunity to change feeding practices than milk-only diets.

> *"…I think if she is hungry then she is hungry … they obviously say that they need all your nutrients from milk and I'd feel, I'd feel bad sort of taking that away from her, but I think when she is weaning I think that's when I would sort of think about what I am giving her"* (P13)

However, parents expressed anxieties and a lack of confidence associated with feeding their baby "correctly" and achieving the perceived social expectations of infant feeding.

> *"Yeah, we are a bit clueless to be honest"* (P14)

> *"…I used to sit and cry over it when she'd gone to bed …"* (P10)

Participants reported a lack of information and support around weaning from health professionals and described searching for information and reassurance that they were doing things correctly on the internet or through talking to peers.

> *"Cos the one thing I would say that's not out there is that you have no idea of what portion size to give your baby they, no one really tells you how much you should be giving a baby"* (P6)

4.9 Summary of findings

The study highlights both the barriers and benefits of identifying and communicating the future risk of obesity to parents of infants. Parents believed that they would recognise their infant as overweight and despite perceiving that they might feel negative as a result, they were receptive to learning about their infant's future risk. Parents saw risk communication as a cue to action, which is consistent with theoretical models of behaviour change (Rosenstock, et al. 1988). Parents were concerned about infant overweight and discussed the likely continuation of excess weight from infant to childhood and wanting to prevent this, as a reason for wanting risk information. Overfeeding was perceived as the main cause of infant overweight, particularly amongst formula-fed babies, and parents saw themselves as both responsible for and in control of, both the development and prevention of excess weight during infancy. Parents' receptiveness to risk communication and preventative feeding interventions were associated with the developmental milestones of walking and weaning. Walking was seen as a significant milestone for gauging infant overweight, with concerns realised if excess weight persisted. The idea of preventative feeding interventions, particularly reduction of infant formula prior to the introduction of solid food, was viewed as denying an infant's needs.

4.10 Discussion

In line with the themes identified, findings are discussed under three main headings: the identification of infant overweight and future risk, the consequences of infant overweight status, and parental attributions of causality, responsibility, and control.

4.10.1 Identification of infant overweight and future risk

Parents talked openly about overweight and obesity as a societal issue and personalised the issue of overweight when discussing their own infants (subthemes 1a and 1c). The possibility of overweight in infancy was similarly acknowledged amongst parents of infants in a recent study (Dinkel, et al. 2017) however, none of the mothers referenced their own infant as overweight. Understanding how parents perceive a healthy weight is an important step in the prevention of obesity. In recent years parental perception of childhood weight has been frequently studied and suggests that between 50-70% of parents incorrectly perceive their child's weight status against objective measures of body weight (Rietmeijer-Mentink 2013; Lundahl 2014; and Tompkins, Seablom and Brock, 2015). The existing evidence suggests that factors such as parental overweight and young child age reduce the accuracy parental perception (Rietmeijer-Mentink, 2013). Parental perception of overweight during infancy is poorly understood however, the limited research indicates that parental perception is poor, particularly at around 12 months of age (Brown, et al. 2016). Parental accounts of how they would recognise infant overweight within this study relied upon subjective observations of infant overweight not objective measures of a measured body weight. Subjective observations of overweight such as comparison to peers and clothing sizes have been previously noted (Garrett-Wright, 2010). Mareno argues that current definitions of parental perception of childhood weight are inadequate and lack a conceptual definition and conceptually defines parental perception as, "a parent's judgement of their child's body weight" (Mareno, 2014). The study identifies five attributes that formulate perception including, parent recognition of body size, physical appearance, functional abilities, psychosocial effects and health effects of current weight (Mareno, 2014), some of which were articulated by parents in this study. The multidimensional nature of parental perceptions discussed by Mareno highlights the pitfalls of relying upon the objective measures of weight commonly utilised by health professionals and supports that of Parkinson who suggests that the inclusion of subjective measures when talking about weight could improve parental engagement (Jones, et al. 2011). Jones and colleagues (2011) also highlight contextual factors that may influence parents' ability to determine their child's weight.

For example, when asking a mother if her child is overweight, aside the call for factual knowledge about their child's relative weight, there is a lack of recognition of 'overweight' as being an evaluative term and implies that the child is heavier than is desirable. This in turn may affect parental ability to accurately determine weight and influence their desire to do so (Parkinson, et al. 2015). Parents use of personalised language regarding their infants' overweight status within this study is novel and given that poor personalisation of overweight in parents may negatively influence engagement (Jones, et al. 2011), is a positive step forward.

This study goes further and reveals that despite parents' perception of an albeit subjective but intuitive recognition of infant overweight, they seek reassurance, not censure regarding their parenting practices in relation to feeding and weight (subtheme 3b). Furthermore, and in support of existing research (Redsell, et al. 2010), stage of infant development emerged as meaningful milestone for parents, with the problematisation of infant overweight not given significance until an infant begins walking (subtheme 1c and 3c). Combined with the finding that greater feeding self-efficacy was associated with the introduction of solid food (subtheme 3b), this suggests that there are several windows (rather than a single window) of opportunity for discussion around weight and weight-related behaviours.

4.10.2 Consequences of infant overweight status

The findings reveal a delay in the point at which parents perceive excessive weight during infancy to be a cause for concern, although continual assurance is actively sought regarding their infant's size and weight, (subtheme 1b). Poor perception of the health risks associated with childhood overweight is suggested as an explanation for lack of parent concern about weight (Tompkins, Seablom and Brock, 2015). However, this study revealed that infant weight is characterised as a gateway to future overweight and adult health risks as reported by Eli and colleagues (Eli, et al. 2014). This might explain the general acceptance of both the validity and utility of risk prediction tools (subtheme 1c). Although health risk and severity perceptions have been associated with prevention in adults (Post, et al. 2015), this study suggests that for parents of infants the discussion might resonate better if framed in terms of future risk.

This study also emphasises the need to provide parents with a plausible rationale to counter the historical emphasis on under-weight rather than over-weight (Baughcum, et al. 2001), which in this study was perpetuated by early interactions with healthcare professionals (subtheme 2a) and common-sense reasoning, such as low birth-weight infants needing to catch-up on their growth (subthemes 1b).

Although parents perceive their ability to manage or achieve an appropriate or healthy weight in their infants as an indication of good parenting (subtheme 2d), adhering to recommended feeding guidelines was not always seen as compatible to having a contented infant; another, independent marker of good parenting (Syrad, et al. 2015) (subtheme 2c). It has been previously reported that healthcare professionals need to support parents when they negotiate their goals associated with child's survival and well-being (in its broadest sense) (Gross 1996).

4.10.3 Parental attributions of causality, responsibility, and control

Parents openly claimed responsibility for both causing infant overweight through overfeeding and preventing overweight through healthy feeding practices, implying that it is within their power to control. Since publication of the paper (Bentley, et al. 2017) research published by Dinkel and colleagues (2017) supports these findings. In their study, parents also identified early introductions of solid foods as causal (Dinkel, et al. 2017. Nevertheless, parental self-efficacy for behavioural change particularly prior to weaning, does not align with an internal locus of control (subthemes 3b and 3c). Parenting self-efficacy is an important determinant of health behaviour change (Bandura 1986) and intervention should support not reduce parenting efficacy. Although there is currently no evidence relating specifically to parental self-efficacy and obesity risk in pre-schoolers (Davies, et al. 2014), self-efficacy is strongly associated with parenting competence and child developmental outcomes (Jones and Prinz 2005) and recognised as an important factor for successful management of childhood obesity (Wright, et al. 2014).

Inconsistencies exist between lay beliefs of the causes and solutions to obesity described by Ogden and Flanagan (2008) and the framing of obesity as requiring expert intervention (Gard and Wright 2005). Clearly, parents are being poorly served by a situation that they perceive to simultaneously blame and disempower them, and this has important implications for the communication of risk, particularly in relation to non-modifiable factors such as maternal obesity (Weng, et al. 2012). This likely explains parents' experiences of, and concerns about, stigma as explained by attribution theory (Crandall and Martinez 1996; Crandall and Reser 2005). Indeed, previous research has demonstrated that causal attributions are associated with stigmatisation in relation to preschool children (Musher-Eizenman, et al. 2004).

4.11 Study Strengths and Limitations

A key strength of this study is the recruitment of parents with an unhealthy body weight with over fifty percent reporting measures resulting in a BMI indicative of overweight or obesity. Self-reported weight measures have been noted as inaccurate with a tendency to over report height (Gorber, et al. 2007), which suggest that a higher percentage of parents may have been overweight and obese than reported. The qualitative methodology of this research was chosen as key to obtaining an in-depth understanding of the parents' views. In order to consider how the role of the researcher may have been as a potential source of bias within the study, reflexivity as guided by Domain 1 of the COREQ (Tong, Sainsbury and Craig, 2007) is considered. The thesis author carried out all the interviews independently. She holds a bachelor's degree in dietetics and a Master's in Public Health and at the time of the study was not in employment and had not practiced as a clinical dietitian for eight years. She had most recently worked within a public health role as a childhood obesity coordinator and prior to that as a public health dietitian for schools. Although beginning her career as a clinical dietitian the researcher, favoured the prevention and not treatment of chronic diseases and her roles reflect beliefs about the importance of the prevention of obesity from childhood. Within her role as childhood obesity coordinator, the researcher was involved in local implementation of the NCMP. Her experience of this, particularly the negative response from some parents to information about their child's weight status and challenges of engaging parents in support services, lead to her interest in this PhD topic. Although a novice at interviewing for the purposes of qualitative research, during both her professional training and work roles, the researcher had experience of eliciting information from a range of clients including parents of infants. She has also received training within motivational interviewing, providing communication skills such as use of open questions.

The professional as a researcher can be a positive and provide insight into participant issues (Gibbs, et al. 2007), however, it may also create bias by negatively influencing participants' openness or willingness to express a critical viewpoint due to the power imbalance (Draper and Swift 2011). In order to minimise bias, as part of the recruitment phase, when visiting children's centres to brief participants about the study the researcher also provided information about herself to parents. She explained her professional background was as a dietitian, and discussed her most recent role as obesity coordinator, explaining that she was no longer working in this role. In particular, she made it clear that the aim of the research was to understand parent's perspectives on infant overweight in an attempt to learn more about how to engage with and support

parents, not to alienate them, as she felt had been a negative consequence of the NCMP.

One major limitation to the research findings is the hypothetical nature of some of the research questions. In many cases participants voluntarily personalised the questions to be in relation to their own infant, however when discussing the anticipated consequences and benefits of being told about future obesity risk, responses were hypothetical. It is also reasonable to assume that parents self-selected for the study on the basis that the topic of childhood overweight was salient to them, and this may have influenced the findings. Positively, this does however suggest some receptiveness or even discussion about infant weight, this with someone perceived as being able to provide insight and reassurance.

4.12 Conclusion

In summary, this study provides further insight into the factors that may (negatively) influence receptiveness to the identification of excessive weight in infancy, the assessment of future obesity risk and behaviour change. Positively, parents demonstrated a hypothetical interest in learning about their infant's future risk of overweight and as shown in previous research acknowledged the benefits of risk assessment (Rudolf, 2011). Risk communication was seen as a cue to action and the opportunity for intervention to prevent future obesity. Parents did, however, anticipate that learning about their infants' risk status, particularly if high, would result in initial negative feelings of guilt, shame, worry and being annoyed and upset. These feelings, although not perceived to interfere or supersede parent's desire for risk information, highlight possible emotional responses that may result from intervention. The findings require consideration from an ethical standpoint (Ten Have, et al. 2011) and highlight the importance of appropriate support to ensure risk assessment does not result in feelings of shame, self-blame and the disempowerment of parents.

As highlighted by Redsell and colleagues (2010), some mothers expressed a reluctance to identify their infant as overweight or being at future risk of becoming overweight, due to fears of stigmatisation and judgement from peers and professionals. The approach and communication style of health professionals was important for parents and demonstrated the importance of non-judgmental communication skills.

As shown previously (Redsell, et al. 2010) parents' openness to the idea of risk assessment was associated with their infants' stage of development, specifically walking. Prior to walking, parents were sceptical about risk assessment. This was due to

perceptions that until infants were walking, their risk could not be accurately established, as any excess ‘puppy’ fat held would be lost once walking. Beliefs surrounding the influence of walking upon infant weight present significant barriers to engaging parent in early obesity risk assessment. A preference for risk assessment at one year would mean that opportunities to influence infant feeding practices, in particular responsive feeding, during the transition to weaning, would be missed.

Other potential barriers to intervention include a low perception of the consequences of excess weight during infancy. Although the tracking of obesity from child to adulthood and adult health risk was acknowledged, parents did not discuss health concerns during infancy. Concerns about underweight also appear to be more worrying to parents than overweight.

Parents in this study reported high levels of personal responsibility around the development of overweight, through overfeeding and prevention of overweight by changing infant feeding practices. However, parental self-efficacy for behaviour change did not align with an internal locus of control and intervention to modify infant feeding practices prior to weaning was met with resistance. Parents perceived that to reduce or modify feeding practices prior to weaning was cruel and would be denying their infant essential nutrition, as milk was their only source of food. Feelings of guilt and feeling like a bad mother were described as the resulting feelings of such actions. The importance of infant contentment is also a significant factor for parents and overrode concerns about overfeeding.

These findings add to the limited research (Redsell, et al. 2010; Rudolf 2011) on parental perceptions of obesity risk assessment during infancy. The findings reveal both the positives and negatives of risk assessment as perceived by parents, as well as the significance of timing. In addition, they provide valuable insight into the factors that may act as barriers for implementation of preventative infant feeding practices and highlight overriding priorities such as infant demands, contentment and concerns about adequate growth. How these perceptions may influence parental engagement is as yet unclear and something that will be further explored through the development of a new quantitative data collection instrument discussed in the next chapter.

Chapter Five

Study Two; Development and psychometric testing of the parental engagement in obesity prevention (PEOP) scale.

5.1 Introduction

This chapter relates to study two, the second step of this two-phase mixed methods research project. The purpose of study two was to build upon the qualitative research findings of study one (Chapter four) in order to develop a new scale to measure parental engagement in obesity prevention (PEOP). As discussed in chapter two there are currently few studies that have explored parental engagement in obesity, particularly obesity prevention during infancy. The predictors of parental engagement in obesity prevention are not yet understood and there is a dearth of empirical evidence to support existing theories.

Study one findings (Bentley, et al. 2017) indicated that parents of infants were receptive to the idea of risk communication. By most it is seen as a cue to action; however, they anticipated that learning about their infant's risk status might induce negative emotions. As previously highlighted by Redsell and colleagues (2010), receptiveness to predicting the future risk of overweight or obesity during infancy may be influenced by infant age. In particular, when an infant begins to walk appears to be a point at which parents may be receptive to learning about future risk. Intention to engage in behaviour change to modify infant feeding practices was also related to infant age and although parents recognised overfeeding as causal for excess growth during infancy, there was a reluctance to modify milk intake prior to weaning. Study one begins to highlight the potential barriers to engaging parents in the prevention of obesity during infancy. Given that parents are the sole providers of care during infancy, understanding the barriers to engaging parents in conversation about infant weight and later obesity risk and interventions to prevent the early onset of obesity, is crucial. The development of this new scale will allow identification of the factors influencing parental engagement and provide a way to assess these barriers amongst parents.

The new PEOP scale will enable health professionals to identify parents who may be less likely to engage or who may require additional support to overcome these barriers. This chapter will describe how the findings of study one and the HBM (Becker, 1974; Rosenstock, Strecher and Becker, 1988) informed the concepts of parental engagement and the development of constructs within the scale. Once constructs were identified, the literature was reviewed in order to identify any existing scales or subscales relating to the salient constructs. Following this, a pool of new and revised items informed by any relevant existing subscales, was developed and the content validity was then assessed. Psychometric testing of the new scale was then performed, which is discussed within Chapter six.

5.2 Study two aim and objectives

- To develop a new measure of parental engagement, the Parental Engagement in Obesity Prevention (PEOP) Scale.

Objectives

- To identify constructs of parental engagement in obesity prevention utilising existing research, qualitative analysis of study one and theory.
- To identify any existing scales or subscale measuring salient constructs to inform the development of a pool of items to capture the constructs and assess the content validity of the items.
- To finalise the items and assess the psychometric properties of scale using exploratory and confirmatory factor analysis.

5.3 Scale development

Development of the new PEOP scale was informed by existing guidelines on scale development (DeVellis, 2003; Cabrera-Nguyen, 2010). Steps taken are outlined below.

5.3.1 Purpose and objectives of new scale

As discussed in previous chapters, there are currently no existing measures of parental engagement in childhood obesity prevention and little is understood about the predictors and barriers to engagement. Therefore, the purpose of this new instrument is to design a new measure of factors that may influence parental engagement in obesity risk assessment and subsequent behaviour change during infancy.

5.3.2 Constructs for inclusion (rationale)

The initial step in the development of a new scale is to identify the constructs for measurement within the scale and those reflecting the latent variable, in this case parental engagement. A construct is a theoretical concept and defined as 'An idea or perception resulting from a synthesis of sense of impressions' (Guralnik 1976) and identification of appropriate constructs is an intuitive process. As discussed in previous chapters, the construct's new models and measures should be based on existing theoretical models (Finan, et al. 2018). The inclusion of the constructs for this scale was therefore informed by the HBM (Becker 1974; Rosenstock, Strecher and Becker 1988) and qualitative findings of study one (Table 9).

Table 9 Themes and subthemes (Study One)

Theme 1: Parental recognition and identification of infant overweight and future risk
1a) Overweight as a concept that can be applied to infant
1b) Trust and mistrust of professional growth assessment
1c) Receptiveness to risk prediction and intervention by healthcare professional
1d) Perceived consequences of risk communication
Theme 2: Consequences of infant weight status
2a) The relative impact if overweight versus underweight
2b) The progressive nature of consequences associated with overweight
2c) The importance of infant contentment
2d) Good parenting and the fear of negative judgement
Theme 3: Parental attributions of causality, responsibility, and control
3a) High parental responsibility for overfeeding
3b) Low parental self-efficacy for changing infant feeding behaviour

In order to begin informing and shaping the constructs for inclusion in the new scale, any relevant overarching constructs or areas of existing research were identified. A particular focus was put upon finding any existing constructs that reflected study one findings and the conceptual framework, for example self-efficacy. The concepts and/or constructs thought as salient for this research are shown in Table 10. As shown, a number of relevant areas reflecting study one research findings were identified. Details of the constructs and how they related to both the HBM (Becker, 1974; Rosenstock, Strecher and Becker, 1988) and the subthemes of study one, are discussed in more detail below.

Table 10 Constructs and related subthemes

Theme 1: Parental recognition and identification of infant overweight and future risk
Parent perception/recognition of infant/toddler/child overweight (1a and 1c) Risk perception/health risk perception (2a and 2b)
Theme 2: Consequences of infant weight status
Guilt and shame (Tangney 1989; Tangney 1996) (1d and 3b) Fear of negative evaluation (Leary 1983) (1b and 2d) Self-blame (Janoff-Bulman 1979,1992) (1d and 3a)
Theme 3: Parental attributions of causality, responsibility, and control
Causal Attributions (Fishman 2014) / Locus of Causality (Weiner 2010) (3a). Responsibility Attributions (3a and 1b) Weiner (1993, 2006) Perceived Personal Control (PPC) Berkenstadt et al .1999 (3b) Self-efficacy (3b) (Bandura 1977). (3b)

Theme 1:

Parental recognition and identification of infant overweight and future risk.

Two relevant existing concepts relating to theme one were identified within the literature: perception of childhood overweight and health risk perceptions. Parental perception of infant weight represents the findings of theme 1a (overweight as a concept that can be applied to the infant) in which mothers believed they would be able to recognise overweight or rapid growth in their infant. As asserted by the HBM (Becker, 1974; Rosenstock, Strecher and Becker, 1988), recognition of infant overweight could have positive implications for engagement due to an increased perception of susceptibility. Given the importance of parents' perceptions of susceptibility for engagement, this construct was seen as relevant to inform the new scale. The construct of risk perception or health risk perception (Table 10) was also deemed relevant to inform the new PEOP scale. The perception of risk represented subtheme 2b of study one (The progressive nature of the consequences associated with overweight) which related to parents' perceptions of the consequences of their infant being overweight. Findings from study one suggests that parents did not perceive that overweight during infancy had any immediate health risks and any concerns about health were discussed in relation to the future. Theoretically, risk perception is seen as prerequisite of behaviour change and underpins most theoretical models of behaviour change, including the HBM (Becker, 1974; Rosenstock, Strecher and Becker 1988), which is the conceptual framework of the thesis. A low perception of risk amongst parents may have negative implications for engaging parents in initial conversation about their infant overweight and openness to risk assessment.

Theme 2: Consequences of infant overweight status

For theme two, three constructs were identified and relevant: guilt and shame, fear of negative evaluation (FNE) and self-blame. The constructs of shame and guilt/ parental shame and guilt reflected subtheme 1d (benefits and harms of risk communication) in which parents perceived that they would feel ashamed or guilty for not acting in their child's best interests upon learning of their infant's risk status. Guilt and shame are described as emotions of self-assessment (Tangney, Stuewig and Mashek, 2007) and both are commonly associated with motherhood (Liss, Schiffrin and Rizzo 2013). Guilt and 'feeling bad' was also expressed by mothers in response to suggestions to modify infant feeding practices (subtheme 3b). This was underpinned by a belief that they would again not be acting in the best interests of their infant, with reduction of milk seen as neglecting an infant of its nutritional needs. These emotions expressed by parents could act as a barrier to receptiveness to risk communication and behaviour change and have a negative influence upon parental engagement. Given this maternal guilt and shame were therefore considered important constructs for inclusion within the new scale.

Subtheme 2d (good parenting and fear of negative judgement) reflected parents' fears of being negatively judged or seen as a bad parent if their child was overweight. Parental concerns about being judged were also raised in 1b (trust and mistrust of professional growth assessment). Judgement was feared from both health professionals and other parents and in relation to both subthemes, presenting a potential barrier to the professional identification of overweight or risk status. Fear of judgement/negative evaluation may act as a barrier to engagement and so was considered to be important to inform the scales development.

Self-blame/parental self-blame also partially represented subthemes 1d (perceived benefits and harms of risk communication) and 3a (high parental responsibility for overfeeding). Self-blame is divided into two constructs: behavioural, attributing blame for a situation to one's past behaviours and characterological negative feelings and poor adjustment because of personality characteristics that typically are stable and resist change (Janoff-Bulman, 1979,1992). The feeling of self-blame expressed by parents could again have negative implications upon engaging parents in assessment of risk and making positive behaviour changes to modify infant feeding practices and was therefore considered an important construct for inclusion.

It should also be noted that when discussing the benefits and harms of risk communication (1d), parents did see this as potential cue to action. Parents also

articulated that they would rather know than not know and perceived that negative feelings would subside. In line with the HBM should the negative feelings such as self-blame and fear of judgement (the barriers) outweigh the perceived benefits to action then this may be detrimental to engagement.

Theme 3: Parental attributions of causality, responsibility and control

Four constructs were identified under this theme of which two, self-efficacy and casual attributions/locus of causality, had relevance to the subthemes of study one. Causal attributions and locus of causality were also identified. Causal attributions are explanations that lay people give for outcomes or behaviours (Fishman, 2014) and locus of causality refers to whether the cause is seen as internal or external of a person (Weiner, 2010). These constructs related to subtheme 3a in which parents articulated that overfeeding, particularly amongst formula fed babies, was a causal factor of excess weight during infancy. To further understand the potential influence of parents' casual attributions for infant weight and how this may influence engagement, this construct was considered relevant for inclusion in the new scale. Responsibility attributions (Weiner, 1993; 2006) and perceived personal control (PPC) (Berkenstadt, et al.1999) also represented subthemes of study one but were not taken forward to inform the scale, as they did not fit with the conceptual framework of the thesis and self-efficacy was considered a more appropriate construct for inclusion.

The well recognised construct of self-efficacy was also identified as relevant and represented subtheme 3b (low parental self-efficacy for modifying infant feeding) of study one. Self-efficacy is defined as an individual's confidence to perform a particular behaviour successfully (Bandura, 1977). It isrecognised as a strong predictor of the uptake and maintenance of health behaviours (Bandura, 1997) and is included within many theoretical models, including the HBM (Becker, 1974; Rosenstock, Strecher and Becker 1988). For both the management and prevention of childhood obesity the positive role of self-efficacy is well evidenced (Taveras, Mitchell and Gortmaker 2009; West and Sanders, 2009). Findings of subtheme 3b demonstrated an uncertainty and reluctance among parents to modify infant feeding practices to influence infant weight, with some expressing a lack of confidence about feeding their baby 'correctly'. Theoretically (Badura, 1997), this low level of self-efficacy could have negative implications for the engagement of parents in preventative lifestyle behaviours. Given the theoretical importance of self-efficacy as a construct and study one findings, this construct was considered important for inclusion within the new scale.

In summary, six overarching constructs were identified as theoretically relevant and taken forward as search terms in a review of the literature: perception of childhood overweight; perception of health risks; guilt and shame; fear of negative evaluation; causal attributions; and self-efficacy.

5.3.3 Identification of existing scales and subscales constructs.

Following identification of the six overarching constructs above, extant literature was searched to identify specific areas of research relating to child or infant weight that further reflected study one findings. Literature was also searched for any existing scales or subscales. The purpose of this step was to identify any existing relevant literature, in particular, existing scales that might be useful to be included within or to inform the development of, the new PEOP scale. Due to the lack of existing literature relating specifically to infants or childhood weight, search terms were kept broad. The quality of any existing scales was then assessed through measures of reliability and validity. Measures of reliability assessed included homogeneity (or internal consistency), stability and equivalence (measured by inter-rater reliability).

Search Criteria

The detailed literature search was performed in October 2015. EBSCO Host was used to access seven databases used for the search: MEDLINE; Child Development and Adolescent Studies; CINAHL Plus with Full Text; Psyc ARTICLES; Psychology and Behavioural Sciences Collection; PsycINFO; PsycTESTS). The search mode was Boolean/Phrase. Following the search, relevant papers were identified via a review of their title and abstract and any duplicates removed.

Inclusion/Exclusion criteria

Papers utilising an existing scale or developing a new scale measuring were included. Those utilising a specific subscale of a composite scale were also included. Publications in other languages were excluded. When necessary, due to the lack of specific obesity related literature, the search omitted the term 'childhood obesity' to allow for identification of scales measuring the overarching constructs that might be of use. Due to the lack of literature specifically relevant to infancy, scales developed and utilised within samples beyond parents of infants were also included. Due to the lack of existing literature in this specific area, studies using qualitative research methods to explore constructs of interest were also included.

Search Terms

The search terms used in each of the six searches varied slightly, depending on the volume of literature relating to the construct. In instances where there was a lack of existing literature, search terms were broader, for example when looking for scales measuring parent perception of 'infant overweight'; if the search returned nothing or very few, then 'childhood overweight' would be used in addition.

Table 11 provides the details of the search terms used for construct one. Full details of all the search terms used for the other constructs is provided in Appendix D.

Table 11 Search terms (Parent Perception of infant weight)

(parent* perception) AND ((preschool overweight OR preschool obesity)) AND (measure or scale or inventory or assessment or questionnaire or instrument)
(parent* perception) AND ((toddler overweight OR toddler obesity)) AND (measure or scale or inventory or assessment or questionnaire or instrument)
(parent* perception) AND toddler weight AND (measure or scale or inventory or assessment or questionnaire or instrument)
(parent* perception) AND ((infant weight OR infant overweight OR infant obesity))
(parent* perception) AND (infant weight OR infant overweight OR infant obesity) AND (measure or scale or inventory or assessment or questionnaire or instrument)

5.3.4 Search results

The results providing the name of the scale, constructs measured, and psychometric properties are provided in Tables 12-16. For ease to the reader all the tables of results are presented at the end of the results section.

Search 1: Parent perception of infant/toddler/child weight

Due to the dearth of literature relating specifically to parent perception of infant weight, search terms included studies looking at toddler and pre-school weight (Table 11). Results of the search identified four relevant studies and two existing scales; however, neither of the existing scales measured parent perception of infant overweight (Table 12). Existing scales identified included the child-feeding questionnaire (CFQ) (Birch, et al. 2001) and the Toddler Silhouette Scale (TSS) (Hager, McGill and Black, 2010). The CFQ scale was included due to one subscale that related to the construct of interest (parent's perceptions of their child's weight status). The three-item subscale showed a good level of reliability, with Cronbach's alpha coefficient of 0.83. The CFQ is a well-utilised and reliable scale (Cronbach's $\alpha > 0.70$ for all 7 factors). Construct validity has been demonstrated through exploratory and confirmatory factor analysis. The scale is

currently only validated for use with parents of children between 2-11 years old; however, the search did reveal a study utilising the subscale to examine parental perception of child weight in the first two years-of-life life linked with infant feeding (Mussad, Donovan and Fiese, 2015). The study sample was parents of infants 22–63 months old who were asked retrospectively about how they perceived their infants' weight to be at 0-11 months using items of the CFQ. The search also identified the Toddler Silhouette Scale (TSS) (Hager, McGill and Black, 2010). The TSS is another well utilised valid and reliable scale. It was developed using photographs of toddlers aged 12–36 months old and is validated for use in male or female toddlers of varying race/ethnicity. Similarly, to the CFQ, this was not utilised as is not relevant for the age group.

It should be noted that the existing scales assess parents' ability to accurately determine their infant or child's weight status against standardised growth charts. This differs slightly from the focus of the construct for the PEOP which does not intend to assess against actual body weight but to assess parents' perceived self-efficacy to identify or recognise overweight and obesity within their baby and the support required to do so. Therefore, this construct is defined as maternal self-efficacy to identify infant overweight (not ability to accurately do so).

Search 2: Parent perception of health risks of overweight.
Terms used within the search are detailed in Appendix F and results are summarised in Table 13. The search identified ten studies measuring parental or maternal perception, knowledge or concerns about the health risks of childhood overweight and obesity. Eight were cross-sectional surveys, one was a descriptive correlation study and one was mixed methods. None of the studies examined the perceptions of parents of infants, three were parents of children aged two years and over (Nsiah-Kumi, et al. 2009; Adams, Quinn and Prince, 2005; Chan and Wang,2013) whilst the others were within samples of parents of school aged children. Reliability was only assessed in three of the studies, one by test-retest reliability (Nsiah-Kumi, et al. 2009) and the other two, through internal consistency reliability (Rutkowski and Connelly 2011: Alexander, Alfonso and Coa, 2016). An acceptable Cronbach's α was demonstrated by the latter. Alexander and colleagues also went on to assess construct validity through factor analysis; however, the results of the CFA did not demonstrate a good model fit. Warschburger and Kroller (2009, 2012) published two papers looking specifically at maternal knowledge of health risk using an existing scale; however, psychometric properties of the original scale were not reported in the papers, and it was never published in English.

Most of the studies related to the development of new measures or adaption of existing scales, although one fully utilised the Obesity Risk Knowledge Scale (ORK) (Swift, Glazebrook, and Macdonald, 2006). The ORK is a validated and reliable scale which was originally designed for use in adults or children over 12 years (Rutkowski and Connelly, 2011) and therefore, was not suitable for this study. In summary, the search failed to identify any existing scales, subscales or items relevant for use in the new PEOP scale.

Search 3: Parental/maternal guilt and shame (related to childhood overweight/guilt associated with reducing milk).
Search terms used are detailed in Appendix F and results summarised in Table 14. The overarching constructs of guilt and shame are well researched, and several existing validated scales were identified in the literature (Harder and Zalma, 1990; Marschall et al. 1994; Cohen, et al. 2011). Scales measuring parental or maternal guilt also exist (Martinez, et al 2011; Kuhn, and Carter, 2006). Guilt and shame are emotions commonly reported amongst mothers who choose to formula feed (Lee, 2007; Lakshman, Ogilvie and Ong, 2009) as well as breastfeeding mothers (Taylor and Wallace, 2012). Despite this body of literature, no scales measuring guilt or shame in relation to feeding were identified, \; however, there was one existing scale which examined maternal guilt and childhood obesity (Persky, et al. 2015a). The Mothers' Guilt Reactions Scale (Persky, et al. 2015a) assesses mothers' guilt related to children's lifestyle behaviours and passing down a genetic propensity for obesity to their child. Maternal guilt is assessed by a four item scale, two relating to the child's lifestyle and two related to passing down genetic risk for obesity. These were newly developed items and not validated or assessed for reliability. Due to the items being designed for use in relation to genetic risk and the lifestyle behaviours relating to that of older children, this subscale was not utilised within the new scale.

The construct of self-blame has not yet been studied in relation to childhood overweight; existing literature relates to self-blame and cardiovascular disease (CVD) or cancer for having behaviours that may have contributed to such conditions (Bennet, Howarter and Clark, 2013; Glinder and Compass, 1999). In relation to adult obesity, studies have measured self-blame in relation to overeating (Conradt, et al. 2009), using the shame and guilt concerning eating scale (Frank, 1991). Quantitative measures of parental self-blame were not evident within the literature; there is qualitative literature in this area that studies self-blame amongst children with autistic spectrum disorder (Levison, 2014) special needs (Mickelson, Wroble and Helgeson, 1999) and adolescent mental health disorders (Moses, 2010).

Search 4: Fear of negative evaluation/judgement about weight.
Search terms are shown in Appendix F. The search returned no studies or existing scales measuring maternal fear of judgement in relation to childhood overweight or obesity. The review did identify The Brief Fear of Negative Evaluation Scale (BFNE) (Leary, 1983). The twelve-item scale measures the degree to which people experience fear of being negatively judged. Items include statements such as “I am afraid that others will not approve me”; “when I am talking with someone, I worry about what they may be thinking about me”; “I am afraid that people will find fault with me”. The scale is reliable and has been validated for use with undergraduates (Leary, 1983; Miller, 1995). Although not yet used in relation to obesity, some of the items were deemed as useful to inform the writing and development of the new scale items for this construct of the PEOP scale. The items were amended to be relevant to the context of judgement about child weight.

Search 5: Parent/maternal perceptions of causal attributions of infant overweight.
Search terms are provided in Appendix F and results in Table 15. Within the adult literature, The Lay Perception of Obesity Scale (McFerran and Mukhopadhyay, 2013) and The Causal Attributions Scale (Niederdeppe, et al. 2014) were identified. These scales assess lay perceptions of the causes, consequences, and potential solutions to adult obesity and how this influences support for public policy so were not considered relevant for inclusion. The search identified six studies, four of which were qualitative studies (Covic, Roufeil and Dziurawiec, 2007; Chambers and Traill, 2011; Hardus, et al. 2003; Sikorski, et al. 2011) and the other two (Trigwell, et al. 2014; Andersen, Christensen and Sondergaard, 2013) were questionnaires; however, neither assessed for reliability, or construct validity. None involved parents of infants and most related to activities of older children seen as causal, such as too much television or use of a computer. Two of the qualitative studies explored the views of parents of younger children, one involving preschool age children in Mexico (Small, et al. 2009) and the second, a Canadian study of infants aged up to three years old (Akhtar-Danesh, et al. 2011). These provided useful insight but did not inform the items developed for the PEOP scale.

Search 6: Parent/maternal self-efficacy (to prevent overfeeding/influence weight through feeding).
Search terms used to identify literature and scales relevant to this construct are shown in Appendix F, and results shown in Table 16. The results identified eight studies, all of which detailed the development of a new scale and some went on to validate the scale.

Most were concerned with the measurement of parental self-efficacy (PSE) to promote healthy eating behaviours, promote a healthy weight or to limit healthy foods. Seven out of eight of the scales related to behaviours of children aged three years and over. One explored the efficacy of parents at two different time points of their child's age (Campbell, et al. 2010) but only explored efficacy and solid foods, not milk feeding, so was not relevant.

One study did investigate maternal self-efficacy in relation to milk feeding within a UK sample of children aged one year and under (Lakshman, et al. 2011). Lakshman and colleagues (2011) developed a new questionnaire to assess maternal attitudes towards infant growth and milk feeding practices. The 57 item questionnaire had four domains: maternal infant milk feeding practices; mothers' decision making regarding how much and how often to feed their babies; attitudes to infant feeding and growth; and beliefs about following infant feeding recommendations. Eleven of the items sought to assess maternal self-efficacy in infant growth monitoring and feeding, so that her baby would not gain too much weight; this was deemed very relevant. Reliability was only assessed in 11 of the 57 items; these were the theory-based beliefs, self-efficacy, outcome-expectancies, and intentions about following recommendations to reduce formula-feed quantities. Both outcome-expectancies and intentions showed acceptable levels of reliability. Although not assessed for reliability, the items of most interest for the PEOP scale were those relating to general attitudes towards infant feeding and growth. The items were: 'I am confident that I can feed my baby so they do not gain too much weight'; 'I am confident that I can feed my baby so they gain enough weight; and 'I am confident that I can follow the new feeding recommendations even if my baby cries between feeds'. Due to their relevance, the wording of some of these items was used to inform the development of items for the new scale. Although the seven item scale demonstrated good reliability, these were not utilised to inform the PEOP scale due to the items not being relevant to children under a year old.

In summary, the results provided good insight into the existing literature and scales measuring the overarching constructs originally identified. However, the search also confirmed that there were no existing scales measuring the specific areas required for the PEOP scale. Neither are there any subscales suitable for inclusion in the PEOP scale, although items within two of the scales were relevant and helped to inform the development of items for the PEOP (Leary, 1983; Lakshaman, et al. 2011). The lack of existing reliable and validated tools is most likely explained by the specificness of this research project to explore the perceptions of parents of infants and weight. This further supports the rationale for the development of a new scale to examine factors influencing

the engagement of parents of infants in the prevention of childhood obesity. As discussed above, ensuring that constructs are well defined is a key step in the development of a new instrument. Therefore, in the absence of existing specific constructs, six new theoretically relevant constructs reflecting study one findings were proposed:

- Construct 1: Self-efficacy to prevent overfeeding/influence weight through feeding
- Construct 2: Self-efficacy to identify overweight in infancy
- Construct 3: Perception of health and other related risks of infant overweight
- Construct 4: Perceptions of the causes of infant overweight
- Construct 5: Guilt, shame and self-blame related to infant overweight and guilt associated with reducing infant milk.
- Construct 6: Fear of negative evaluation/judgement about infant weight

Table 12 Parent perception of infant/toddler weight

Scale/study and author	Study objective and sample	Construct/s and method of measurement	Reliability (Internal consistency /Stability/Equivalence)	Validity (Content/Construct/ Criterion)
Child Feeding Questionnaire (CFQ) (Birch, et al 2001).	To test the factor structure of the CFQ, using previous pilot testing and exploratory analyses as a framework for the hypothesised structure. Assess internal consistency and validity of CFQ in both samples. Confirmatory factor analysis tested a 7-factor model. 660 parents of children 2-11yrs USA – Pennsylvania and Denver, CO.	Questionnaire: 7 factor, 28 item 5-point Likert-scale 4 factors measuring parental perceptions related to child's obesity proneness (perceived responsibility, parent weight, child weight, concern about child weight) and 3 factors measuring parental control practices and attitudes regarding child feeding (pressure to eat, restriction, monitoring).	Cronbach's α $\geq$ 0.70 for all 7 factors. Responsibility = 0.88 Parent weight = 0.71 Child weight =0.83 Concern = 0.75 Pressure to eat = 0.70 Restriction = 0.73 Monitoring =0.92	Construct validity CFA
Parental perception of child weight in the first two years-of-life (Mussad, Donovan and Fiese, 2015).	To assess parental perception of child weight in the first 2 years-of-life and if there is a potential link between infant feeding and pre-schoolers' diet. 497 parents of infants 22– 63 months old. (Assessed at 0–11 months and 12–23 months). USA – Illinois	Calculated from the 2 CFQ items. Perceived child weight; Your child during first year of life; Your child as a toddler. 5-point Likert-scale. (Birch, et al. 2001).	NP	Not validated for use in children under 2 years.

7-image Toddler Silhouette Scale TSS, (Hager, McGill and Black, 2010).	To develop and validate the toddler silhouette scale for toddlers, aged 12–36 months, of varying race/ethnicity.	7 point scale based on photographs of toddlers (6 males, 9 females) varying in race/ethnicity and body size, and a list of phenotypic descriptions.	Inter-rater reliability, based on matching silhouettes with photographs, was 0.787 and the intra-rater reliability 0.855 (Cronbach's α, $P < 0.001$). (Assessed by 138 paediatric health professionals matching the silhouettes with photographs of toddlers).	Content validity (age-appropriateness, and gender and race/ethnicity neutrality) (Assessed by 180 paediatric health professionals and 129 parents of toddlers). Concurrent validity based on the correlation between silhouette choice and the weight-for-length percentile of each toddler's photograph, was 0.633 ($P < 0.001$). (Assessed by having 138 paediatric health professionals match

				the silhouettes with photographs of toddlers).
Maternal Perceptions of Toddler Body Size (Hager, et al. 2012). Cross-Sectional Study	To examine accuracy of maternal perceptions of toddler body size; factors associated with accuracy of toddler body size; and how maternal satisfaction relates to accuracy/toddler body size. 281 mothers of toddlers 12-32 months.	7-image Toddler Silhouette Scale TSS (Hager McGill and Black, 2010).	As above	As above

NA: Not applicable. NP: Not performed

Table 13 Parent/maternal perception of risks of childhood obesity (Construct 2)

Scale/study and author	Study objective and sample	Construct/s and method of measurement	Reliability (Internal consistency/ Stability /Equivalence)	Validity (Content/Construct/ Criterion)
Childhood obesity: do parents recognize this health risk? (Etleson, et al. 2003).	To examine parents' understanding of excess weight as a health risk, knowledge of healthy eating habits, and recognition of obesity in own children. 83 parents of 4-8yr old children. USA	Multiple Choice Questionnaire (10 item) Level of concern about excess weight and other familiar health risks. 4 point Likert scale.	NP	NP
Care giver perception of children's obesity-related health risk: a study of African American families (Young-Hyman, et al. 2000).	To examine care giver perception of children's weight-related health risk. 111 African American families. No age provided	Questionnaire Perception of child weight, eating habits, appearance, exercise habits, and health risk.	NP	NP
Family history and parents' beliefs about consequences of childhood overweight and	To examine factors related to parental perception of health	Survey – Newly developed (not based on any previously validated tools)	Test-retest	NP

their influence on children's health behaviors (Nsiah-Kumi, et al. 2009).	risks for overweight children. 386 parents of 2 to 17year olds USA	Perceptions of and concerns about child health and weight status. http://www childrensmrc.org/pprg/resources/obesity.		
Low recognition of childhood overweight and disease risk among Native-American caregivers (Adams, Quinn, and Prince 2005).	To assess parent recognition of overweight. and caregiver attributes associated with concern for risk of future overweight and chronic disease. 366 parents of kindergarten children. USA - Wisconsin tribes	Newly developed survey (61 item) Caregiver concern for child's risk of obesity.	NP	"Field tested the survey during the first year and subsequently made slight modifications".
Chinese parental perceptions of weight and associated health risks of young children (Chan andWang,2013). Mixed methods study	To determine caregivers view on preschool children's body size and the associated health risks. 505 caregivers of pre-school children Hong Kong	In depth case studies and Child Body Questionnaire (CBQ) (Chan, et al. 2010a, 2010b) and silhouettes*. *(Based on Stunkard, et al.1986)	NP	Rasch analysis used to assess scale is unidimensional 0.73.

Maternal perception of weight status and health risks associated with obesity in children. (Warschburger and Kroller, 2009).	To examine factors associated with maternal perception of weight status in related and unrelated if physical and mental health risks are recognised. 219 mothers of children 3- 6 years old.	Parents were presented with 9 silhouettes representing different age- and gender-specific BMI percentiles.	Unable to access	Unable to access
Childhood overweight and obesity: maternal perceptions of the time for engaging in child weight management" (Warschburger and Kroller 2012).	To examine parental perceptions of the appropriate time to engage in child weight management strategies, and factors associated with different weight points at which mothers recognise the need for preventive actions. 352 mothers of children 2–10 years old.	Perceptions of actual and preferred weight status, ability to identify overweight, knowledge of health risks, and perceptions of the right time for action to prevent overweight in their child. Validated Silhouettes (for the assessment of male or female weight perceptions in 2- to 4-years or 5- to 10-years old).	Unable to access	Unable to access
Obesity risk knowledge and physical activity in families of adolescents (Rutkowski and Connelly 2011).	To examine the relationship between obesity risk knowledge and physical activity	Knowledge of health risks associated with obesity assessed using	Internal consistency (Cronbach's α coefficients)	NA

Descriptive, correlation study	levels in families of adolescents. 94 parents of 12-15 year old adolescents USA – California	ORK Scale – (10 item) Cronbach's alpha coefficient of .83 in adults (Swift, et al. 2005).	Adolescent scale = 0.53 Parent scale = 0.59	
Perceptions of health risk among parents of overweight children (Park, et al. 2013). Cross-sectional Survey	To identify the socio-demographic and behavioural characteristics associated with perceptions of weight-related health risk. Parents of overweight children 4-11 years old UK	Assessed using 1 question Do you think your child's current weight puts their health at risk? Yes/No	NP	NP
Development and psychometric testing of the childhood obesity perceptions (COP) survey among African American caregivers: (Alexander, Alfonso, and Cao, 2016).	To describe the development and psychometric testing of a survey tool to assess childhood obesity perceptions among African American caregivers in a rural setting,	6 subscales, 39 items Outcome expectations (12 items) Moral disengagement (7 items) Environment (8 items) Behavioural capability (5 items) Self-efficacy (4 items) Reinforcement (3 items).	Internal consistency (Cronbach's α coefficient) Outcome expectations - (a = 0.85) Moral disengagement (a = 0.82)	Construct validity - EFA and CFA performed. CFA resulted in less than adequate fit.

	135 parents of 3-5th grade students USA – Georgia		Environment (a = 0.74) Behavioural capability (a = 0.79) Self-efficacy (a = 0.70) Reinforcement (a = 0.75).	

NA: Not applicable. NP: Not performed

Table 14 Parent/maternal guilt and shame in relation to childhood overweight (Construct 3)

Scale/study and author	Study objective and sample	Construct/s and method of measurement	Reliability (Internal consistency/Stability/ Equivalence)	Validity (Content/Construct/ Criterion)
Mothers' guilt responses to children's obesity risk feedback (Persky, et al. 2015).	To explore the influence of family health history-based childhood obesity risk feedback and mothers' guilt related to children's lifestyle behaviours and passing down a genetic propensity for overweight. 147 Mothers of 4-5yr olds with self-reported body mass index (BMI) of ≥ 25.	Mothers' guilt reactions, measured by items created for thestudy, no relevant measures existed. Mothers' guilt and shame about their own weight measured with 5 items of the Weight- and Body- Related Shame and Guilt Scale (Conradt, et al. 2007).	NP Cronbach's α of original scale (Conradt, et al. 2007) Shame = 0.92 Guilt = 0.87 NP for this study	NP

NA: Not applicable. NP: Not performed

Table 15 Parental perceptions of the causes/causal attributions of childhood overweight (Construct 5)

Scale/study and author	Objective of study and sample	Construct/s and method of measurement	Reliability (Internal consistency/Stability/ Equivalence)	Validity (Content/Construct/ Criterion)
'We've always eaten healthily': Family narratives about causes of their child's obesity and their motivation for taking action (Grønbæk, 2008). Qualitative	To analyse family insight regarding their child's overweight, the development of obesity, and motivational factors for taking action in relation to the family's socio-demographic conditions. 53 families of obese children aged 10-12 years.	Qualitative, thematic analysis recorded clinical interviews.	NA	NA
Ethnic differences in parental attitudes and beliefs about being overweight in childhood (Trigwell, et al. 201).	To examine the relationship between ethnic background and parent's views on body size, concerns about overweight and perceived causes of childhood overweight. 808 parents from minority ethnic groups of children aged 4-16 years old	Perceived cause of childhood overweight. Questionnaire (Newly developed) 1 Multiple choice question 'What do you think causes children to become overweight?'; response options: 'not enough physical activity', 'eating too much', 'eating the wrong kinds of food', 'illness/ injury', 'genes',	NP	NP

	UK – Liverpool	'too much television and computer', 'other').		
Contributors to childhood obesity in Iran: the views of parents and school staff (Mohammadpour-Ahranjani, et al. 2014). Qualitative	To explore contextual influences on childhood obesity to inform development of an obesity prevention intervention 88 parents and school staff of 6-8yrs olds. Iran (Tehran)	Focus groups and interviews. 11 focus groups and 3 interviews	NA	NA
Child overweight in general practice - parents' beliefs and expectations (Andersen, Christensen and Sondergaard, et al. 2013). Cross-sectional survey	To assess parental beliefs about the presumed causes and consequences of overweight in children. 879 parents of children (age not reported). Denmark.	Questionnaire Items based on literature studies and [4,12-17] focus group interviews with GPs and parents of overweight children.	NP	Content validity assessed.
Exploring the meaning of excess child weight and health: shared viewpoints of Mexican parents of preschool children (Small, et al. 2009). Qualitative	To describe the meaning of overweight and its relationship to health as perceived by parents. 11 Mexican immigrant parents of pre-school children. Mexico	Focus groups	NA	NA

Parents' perceptions and attitudes on childhood obesity: a q-methodology study (Akhtar-Danesh, et al. 2011). *Q-methodology	To investigate parents' perceptions of causes of obesity, impact on health, and barriers to successful prevention of childhood obesity. Phase 1: 20 parents of infants up to 3 years old. Phase 2: 33 parents of infants Canada	Phase 1: Questionnaire (open ended) Questionnaire assessed parents' views and attitudes to childhood obesity. Phase 2: Q-sort table with 42 statements.	NA	NA

*Q-methodology (Stephenson, 1982). A by-person factor analysis (i.e., the statistical analysis is performed by person rather than by variable, trait, or statement) is used to identify different factors, and respondents are grouped based on the similarities of their Q-sorts. NA: Not applicable. NP: Not performed

Table 16 Parental or maternal self-efficacy (PSE/MSE) to influence child health behaviours that prevent obesity (Construct 6)

Scale/Study and author	**Study objective and sample**	**Construct/s and method of measurement**	**Reliability (Internal consistency/Stability/ Equivalence)**	**Validity (Content/Construct/ Criterion)**
Development of a questionnaire to assess maternal attitudes towards infant growth and milk feeding practices (Lakshman, et al. 2011). Cross sectional survey	To develop a new questionnaire to assess attitudes towards infant growth, milk feeding practices, mother's self-efficacy in infant growth monitoring and feeding to prevent excessive weight gain. 40 mothers of infants age 1 year and under UK – Cambridge	Questionnaire (57 item) -Type of milk feeding, decision making, and sources of advice (21 items). -Frequency and quantity of feeds (6 items). -General attitudes to infant feeding and growth (11 items). - Theory-based beliefs about following recommendations to reduce formula-feed quantities (11 items) (self-efficacy/outcome-expectancies/intentions).	Cronbach's α Self-efficacy = 0.51 Outcome-expectancies = 0.79 Intentions = 0.90 ($p < 0.0001$). The test-retest reliability (Cohen's kappa) > 66% for 89% (51/57) of the items. Equivalence - inter-rater reliability was high for 56/57 items (agreement above 80%).	Criterion validity - agreement was above 66% for 68% (39/57) of the items.
The Lifestyle Behaviour Checklist (LBC) A measure	To develop and evaluate of a new measure to assess	2 subscales;	Internal consistency – (Cronbach's α coefficient)	Predictive validity – The LBC correctly classified

of weight-related problem behaviour in obese children (West and Sanders, 2009).	extent to which parents experience problem behaviours and how confident they are to manage them. 182 parents of 4-11-year-olds	Problem scale (extent of problem) Confidence scale (Parent confidence to deal with problem). Weight-related parental self-efficacy (PSE)	Problem subscale α = 0.97 Confidence subscale α = 0.92 Test-retest Problem scale r 0.87, p<0.001. Confidence scale r 0.66, p<0.001.	91.1% of participants, (p<0.001).
Psychometric properties of a new measure of parental self-efficacy for promoting healthy physical activity and dietary behaviours in children (Bohman, Ghaderi, and Rasmussen 2013).	To develop new scale The Parental Self-Efficacy for Promoting Healthy Physical Activity and Dietary Behaviours in Children Scale (PSEPAD) and evaluate the psychometric properties. 2232 mothers of 3year old children. Sweden - Stockholm	3 subscales (16 items) Subscale 1: healthy dietary behaviours (7 items) Subscale 2: healthy physical activity behaviours (3 items) Subscale 3 limit-setting of unhealthy dietary or physical activity behaviours (6 items)	Internal consistency of revised PSEPAD Cronbach's α = 0.87 complete scale. Subscale 1; α = 0.75 Subscale 2; α = 0.76 Subscale 3; α = 0.80 Test-retest reliability Factor 1; r .75 Factor 2; r .73 Factor 3; r .69	Discriminant validity demonstrated with measures of parental health LOC (Tinsley and Holtgrave, 1989) and parental self-esteem (Rosenberg, 1965).
Maternal self-efficacy regarding children's eating and sedentary behaviours	To describe parents' views regarding self-efficacy to influence children's eating	4 subscales (12 items) To assess confidence to	Subscale items scores averaged to create alpha; Subscale 1; α = 0.84	NP

in the early years: Associations with children's food intake and sedentary behaviours (Campbell, et al.2010). Cross sectional	and sedentary behaviours at 1and 5 years old. To examine associations between these views and children's eating and sedentary behaviours. Australian mothers of 1-year (n=60) and 5-year-old children (n=80)	influence or control children's eating and sedentary behaviours SE for promoting healthy eating (5 items) SE for limiting non-core foods(4 items) SE for increasing physical activity (1 item). SE for limiting TV viewing. Measures were developed using qualitative Data (Campbell and Hesketh - unpublished) and existing measures of personal self-efficacy (Bandura 1997).	Subscale 2; α = 0.86 Other measures not reported.	
Development and preliminary validation of the Parent Efficacy for Child Healthy Weight Behaviour Scale (PECHWB) (Nelson and Davis 2013).	To develop a new measure of parental self-efficacy for promoting healthy weight behaviours in their children.	4 subscales (41 items) PSE for promoting healthy weight behaviours	Internal consistency (Cronbach's α coefficient) Composite scale α = 0.97 Subscale 1; α = 0.96 Subscale 2; α = 0.96 Subscale 3; α = 0.93	– EFA and performed. CFA demonstrated good model fit in 4 factor model. Content validity assessed. Convergent validity demonstrated against the

	601 Parents of children aged 4–17 years old. Australia		Subscale 4: α = 0.95	Self-Efficacy (SE) subscale of the Parent Sense of Competence Scale (PSOC-E) (Johnston and Mash, 1989). Discriminant validity demonstrated against Depression Anxiety Stress Scale (DASS-21; Lovibond and Lovibond, 1995).
Initial development and testing of a questionnaire of parental self-efficacy for enacting healthy lifestyles in their children. (Decker 2012).	To develop and test a questionnaire to assess parental self-efficacy for enacting healthy diet and physical activity behaviours in their 6- to 11-year-old children. Parents of children 6–11 years old USA	2 subscales (34 items) PSE for enacting healthy diet and physical activity behaviours.	Internal consistency - (Cronbach's α coefficient) Dietary behaviours subscale (DB) α = 0.93. Physical activity behaviours (PAB) subscale α = 0.94. Test-retest reliability Composite scale r .94 DB scale: r .89) PAB scale: r .93) (p < .001)	- only Concurrent validity of composite scale demonstrated against the Self-Efficacy for Exercise Behaviours Scale and SE for Eating Behaviours Scale (Sallis, et al. 1988). Content validity assessed.

Assessing parental self-efficacy for obesity prevention related behaviours (Wright, et al. 2014).	To develop measures of parental self-efficacy for four preventative behaviours; 304 parents of children 4–10 yeas old. Boston – USA	4 subscales (4 items each, 16 in total) Each subscale measured various aspects of PSE relating to diet or physical activity behaviours.	Internal consistency - (Cronbach's α coefficient) Physical activity α =0.80 Fruits and vegetables α =0.84 Sugary drinks α = 0.87 Fruit juice α = 0.86 Test-retest reliability – (Intraclass correlation (ICC)) significant p < .009 all above .80,	Construct validity - (EFA and CFA Performed – Some fit indices of CFA unable to demonstrate model fit. Spearman Rank correlations performed - .13 - .29 (Level of significance not reported)
Parental efficacy and role responsibility for assisting in child's healthful behaviours (Ice, Neal and Cottrell 2014).	To determine the impact parental self-efficacy and parental role responsibility have on child's nutritional, physical activity, and weight categories. 820 parents of 2nd, 5th and 8th grade children USA	2 subscales (17 items) PSE for assisting in their child's healthful behaviours. (7 item) Parent's belief about their role/responsibility in their child's healthful behaviours. (10 items).	**PSE subscale α = 0.82 Role/responsibility α = 0.80 **unclear if the alpha reported is from the existing subscales (Hoover-Dempsey and Sandler 2005) from which these new ones were developed. No detail of	NP

		All items were developed based on previous subscales developed by Hoover-Dempsey and Sandler (2005).	any analysis discussed within paper.	

NA: Not applicable. NP: Not performed

5.3.5 Generate pool of items

The aim of this step was to create a pool of unambiguous, comprehendible pool of items to measure each of the six defined constructs above. To maximise clarity, item development was guided by nine key principles (Nunnally and Bernstein 1994) including: being precise, being brief, dealing with only one central thought in each item, presenting items in a positive language. Conversely, the use of awkward wording, irrelevant information, double negatives, terms like all and none, and indeterminate terms like frequently or sometimes were avoided.

The use of appropriate language and wording when designing the items can minimise potential sources of bias. For example, a common issue is leading bias, which occurs when the use of a leading question can suggest or prompt the desired response. This type of bias was avoided by use of neutral language and avoiding loaded statements. Two other common sources of response bias in relation to questionnaire development include social desirability bias and acquiescence bias (Oppenheim, 1992). Acquiescence bias is the tendency for a respondent to agree rather than disagree to questioning; this was minimised by ensuring that the pool of items included an equal balance of positive and negatively worded items, as recommended by Oppenheim (1992). Social desirability bias is a tendency for those responding to do so in a way that they see as reflecting socially desirable attitudes. This was minimised through wording the question so that a low-prestige answer is equally possible. Wherever possible, the language and words of parents from the qualitative interviews are used to ensure scale items are understandable to them.

To avoid missing values and unreliable answers, the completion of a questionnaire should not require reading skills beyond that of a 12-year-old (Streiner, 2003). This is equivalent of Flesch-Kincaid 6th Grade, which is school year seven in the UK (students 11-12yrs). There is no gold standard of readability level of psychometric scales and several readability formulas are available. The most frequently used methods used in health-related communications are Gunning Fog Index and the Flesch Reading Ease Formula (Clark, Kaminski and Brown, 1990). Due to its availability within the Microsoft Word software, the Flesch Reading Ease formula (Flesch, 1948) is used in this study. Scores range between 0 and 100, where 90-100 are considered very easy and 0-30 is considered very difficult. To aid interpretation, Flesch reading scores were converted into a corresponding Flesch-Kincaid Grade (Flesch, 1948).

The optimum number of items recommended for inclusion within the initial pool of items is debated within the literature. Suggestions include a pool of items between three to four times the size of the intended scale (Devellis, 2012). To balance out any negative effect on respondent load, twice as many items were created than were expected to remain within the final scale. Each of the six subscales representing the key constructs had a minimum of ten items (Kline, 1986).

Item content

A pool of items was designed to measure each of the six constructs. Each pool of items had more than ten items, apart from construct six, which had only nine. When designing the items, negatively worded versions of the same positively worded items were included to ensure an equal balance and prevent acquiescence bias.

Table 17 Construct 1: Self-efficacy to prevent overfeeding/influence weight through feeding (18 items)

1	I am confident that I can feed my baby so they do not gain too much weight
2	I am confident that I can feed my baby so they gain enough weight
3	I am unsure whether I can feed my baby the right amount to prevent them gaining too much weight*
4	I am unsure that I can feed my baby sufficiently to ensure that they are not underweight*
5	I find it impossible to tell whether my baby is drinking too much milk*
6	I am certain that I can stop my baby drinking too much milk.
7	I am unsure whether I can stop my baby drinking too much milk*
8	I do not feel able to resist my baby's demands for milk even if I know they are not hungry*
9	When my baby is crying, I can distract them without using extra milk or food.
10	I am confident that I could stop my baby over-eating once they were on a solid diet and not milk alone.
11	I would feel confident about giving my baby less milk if I thought they were becoming overweight
12	I would not feel confident about reducing my baby's milk*
13	I can tell from my baby's cry whether or not they are hungry or not
14	I sometimes feed my baby to comfort them or help them sleep even if I know they may not need feeding*
15	I would find it difficult to tell if my baby was over-eating solid food*

16	I am confident that I can settle my baby without giving them extra milk or food.
17	I am certain that I can have a happy, content baby without giving them extra milk or food
18	I do not feel confident that I am able to ensure my baby maintains a healthy weight*

(*denotes a negatively worded item, in cases the item is reverse wording of a positive item, the positive item number is shown in brackets)

Table 18 Construct 2: Self-efficacy to identify overweight in infancy (12 items)

1	I am confident that I would be to judge if my baby was bigger than other babies of the same age
2	I am confident that I would be able to judge if my baby was bigger than their brother/sister was at the same age
3	I am confident that I would be able to judge if my baby was overweight or obese
4	I am unsure if I would be able to tell if my baby was overweight*
5	I am unsure if I would be able to tell if my baby was obese*
6	I am confident I would recognise if my baby's weight were affecting development of their movement skills, i.e. starting to stand or walk.
7	I am not sure if I would recognise if my baby's weight was affecting development of their movement skills, i.e. starting to stand or walk*
8	Regardless of what a healthcare professional might say, I am sure that I would be able tell if my baby was overweight
9	Regardless of where my baby's weight is on the growth chart in the 'red book' I am positive that I would be able to tell if they were overweight
10	The only way that I can be certain that my baby has not or does not gain too much weight, is to see where their weight is plotted on the growth chart in the 'red book'*
11	It is not possible to tell if my baby is overweight until they start to walk*
12	My baby's weight is exactly what it should be for their age

Table 19 Construct 3: Perception of health and other related risks of infant overweight (15 items)

1	Many children already weigh too much before they are two years old
2	Many children already weigh too much before they start school
3	Overweight babies are more likely to develop health problems than healthy weight babies

4	In babies, there are no health risks associated with being overweight*
5	Overweight babies are more likely to become overweight children
6	It is unlikely that an overweight baby will become overweight when they are an older child*
7	Overweight babies are more likely to become overweight adults
8	The health risks of being overweight do not become serious until a child starts walking*
9	The health risks of being overweight do not become serious until a child reaches school age*
10	The health risks of being an overweight baby or infant are not serious unless the baby is very, very big or obese*
11	It is more healthy for a baby to be overweight than underweight*
12	It is more of a risk to a baby's health to be underweight than overweight*
13	A happy and content baby indicates a healthy baby*.
14	Being overweight or obese can make it difficult for babies to start walking
15	Being overweight or obese negatively affect a baby's ability to learn and meet their developmental milestones

Table 20 Construct 4: Perceptions of the causes of infant overweight (19 items)

Behavioural (Internal causal attributions)	
1	Babies become overweight when they don't move around enough
2	Babies become overweight because they drink too much breast milk.
3	It is not possible for breastfed babies to become overweight*
4	Babies become overweight because they are overfed bottled or formula milk
5	It is not possible for a formula fed baby to become overweight from too much formula milk*
6	It is not possible for a baby to become overweight when they are on a milk only diet*
Biological (Internal causal attribution)	
7	A baby is more likely to become overweight if its biological mother is overweight
8	A baby is more likely to become overweight if its biological father is overweight.
9	Some babies become overweight because they are hungrier than other babies*.

10	Some babies become overweight because they have slower metabolisms than other babies*
11	Some babies become overweight due to a medical condition*
12	Baby boys are more likely than baby girls to become overweight*
13	Baby boys are less likely to become overweight than baby girls*
14	A baby's weight is not influenced by its parents' weight*
15	A baby's weight is not determined by its genes*
16	Overweight babies are not just born that way*
Maternal perceptions of controllability /perceived personal control	
17	If a baby becomes overweight, there is not much that can be done until they start to walk*
18	A baby's weight can only be controlled when it is eating solid food*
19	There is nothing that parents can do to prevent their baby becoming overweight*

Table 21 Construct 5: Guilt/shame and self-blame in relation to infant overweight and guilt associated with reducing milk/food (16 items)

1	I feel guilty about using formula rather than breast milk to feed my baby
2	I feel guilty about not being able to breastfeed my baby
3	I feel guilty about not trying to breastfeed my baby
4	I was made to feel guilty by others about not breastfeeding my baby
5	I don't feel guilty about choosing not to breastfeed my baby*
6	I don't feel guilty about not being able to breastfeed my baby*
7	I feel guilty that I feed my baby whenever they cry
8	I don't think mothers who choose not to breastfeed their baby should feel guilty
9	I would feel guilty if I didn't feed my baby if they were crying
10	I would feel guilty if I refused my baby solid foods if they were crying for more
11	I feel guilty when I give my baby jarred or readymade foods
12	I would feel guilty if I gave my baby less formula milk than the tin said I should.
13	I often feel guilty about the way I feed my baby
14	I feel guilty about my baby's weight
15	I would blame myself if my baby was overweight
16	I would not blame myself if my baby was overweight*

Table 22 Construct 6: Fear of negative evaluation/judgement infant weight (9 items)

1	I feel comfortable with the way my baby looks*
2	I am comfortable with what other people think of my baby's weight*
3	I get tense when it is obvious that people are looking at my baby
4	I am concerned that people will judge me because of my baby's weight
5	It doesn't worry me what others think about my baby's weight*
6	I worry that other mothers talk about my baby's weight when I am not around
7	I am concerned what the health professionals will say about my baby's weight when I get them weighed in clinic
8	I am concerned that people will think I am a bad mother because of my baby's weight
9	It is acceptable for children to look overweight when they are babies. It is when they get older it is more of a problem

5.3.6 Determining format of the measure

The appropriateness of the choice of response formats used within the scale can depend upon the construct under investigation. This scale measures parental beliefs. When assessing beliefs, it is not possible to categorise responses as just true or false, so response scales such as the Thurstone (1927), Guttman (1950) and Likert (1932) are commonly used. The Likert scaling technique remains the most popular way to measure psychological and behavioural phenomena (Oppenheim, 1992). The Likert scale involves presentation of a declarative statement followed by an option that indicates the degree of agreement or disagreement with the statement. For this study, a seven-point Likert scale was used with response options as follows: strongly agree, agree, somewhat agree, neither agree nor disagree, somewhat disagree, disagree, and strongly disagree.

Scoring

Items indicating maternal self-efficacy to prevent overfeeding were scored highly: strongly agree = 7, agree = 6, somewhat agree = 5, neither agree nor disagree = 4, somewhat disagree = 3, disagree= 2 and strongly disagree = 1. Negatively worded items were scored in reverse. The same rule was applied for the other constructs, so items representing maternal self-efficacy to identify overweight (construct 2), maternal perception of infant overweight as associated to future risks (construct 3), maternal guilt or self-blame (construct 5) or maternal fear of judgement (construct 6) all scored 7 for a strongly agree response. For construct 4, items indicating a maternal perception of an

internal causal attribution for infant weight and a personal responsibility, are scored high.

5.3.7 Content Validity

Following development of the pilot item pools, the items were reviewed by several subject matter experts in order to assess content validity. Content validity examines the extent to which the constructs of interest are as planned, comprehensively represented by the items in the questionnaire (Guyatt, Feeny and Patrick,1993). This process, although subjective, is considered an essential process to check content validity (Terwee, et al. 2007).

The content validity of the item pool was first assessed by the PhD supervisory team (JS, RC, SR). Following this, nine subject matter experts were approached (Table 23).

Table 23 Subject matter expert consulted for purposes of content validity

Expert 1	Research Fellow
Expert 2*	Specialist Public Health Dietitian
Expert 3	Health Visitor
Expert 4	Specialist Health Visitor - Infant Feeding
Expert 5	Specialist Health Visitor - Infant Feeding
Expert 6	Public Health Dietitian
Expert 7	Midwife
Expert 8*	Health Visitor
Expert 9	Specialist Public Health Dietitian

*No response

The experts were initially contacted via telephone or email in February 2016, they were provided with a summary of the study and asked if they would be willing to participate. Following their agreement to be involved, instructions and a simplified version of the pilot item pool was emailed to experts Appendix G. Guidance was given to ensure responses were relevant to construct validity and experts were advised to comment on how well each of the items reflected the construct and were asked a series of questions (Figure 2). The item pool sent to experts did not denote the negative items, details of causal attribution or scoring.

Figure 2*:* Questions asked to experts

Are there any obvious questions you think are missing? Do the questions relate to what they are supposed to be measuring e.g. mother's perception of the causes of overweight? Is the language used appropriate and understandable to mothers? Are the questions understandable; are there any that mothers maybe confused by? Are any of the question's bias, i.e. do you think they would lead the mother to respond in a positive or negative way?

Content Validity Results

Seven out of nine of the experts responded, providing general comments relating to each of the six constructs, item specific comments and some overall comments. The overall comments included positive appraisals such as "Generally, I thought your questions were really comprehensive and well thought out. It was really clear what you were trying to say with each question too" and "I would say all the measures are understandable and I couldn't see anything missing". The other general comments related to ensuring a balance of positive and negatively worded items within each construct and the language being too complex for parents. Opinions about the potential negative impacts and pressure of feeding upon the mental wellbeing of mothers and their perceptions of what is it to feel like a good mother and the influence of culture and maternal overweight, were also raised.

Comments relating to the constructs are discussed below.

Construct one was well received and two of the experts were very positive in their appraisal stating, "Questions definitely cover what it is trying to measure; they are understandable, appropriate language, not leading". Measure one 11 out of 18 (61%) of the items were endorsed (Items 1-4,6,7,12,13,15,16 and 18) by all seven respondents, and all items (100%) by four of the respondents; three respondents had comments about seven of the items (Table 24).

Table 24 Content validity – Construct 1

Mother's Confidence about preventing overfeeding	
5	Expert 1: Not sure about impossible here – wonder if it begs a yes/no answer rather than fitting with the agreement scale?
8	Expert 4: Ambiguous, some mums may wonder why a baby needs feeding if they are not hungry
9	Expert 1: Wonder about word distract – could it be soothe or calm? Expert 4: Does food refer to solid foods? Expert 7: This item be might be better with 13 and 14?
10	Expert 1: This is a very long question, which could detract from readability. Could try 'When my baby is eating solid food as well as milk, I am confident that I will be able to stop him/her over-eating
11	Expert 1: Similarly, I wonder whether 'If I thought my baby was becoming overweight, I would feel confident about giving them less milk' is clearer?
14	Expert 1: Long but I think it is fairly clear Expert 4: The school of thought re: breastfeeding is to do * comfort, breast feeding for security and bonding
17	Expert 1: Extra to what? I think makes this question a bit ambiguous

Expert comment from construct 2 was again positive in relation to the items capturing the proposed construct with one expert stating, "Questions definitely answer the measure". Other general comments in relation to the construct included the suggestion to add an item about growth charts. 8 out of 12 (66%) of the items (items 1-3,8,11 and 12) were endorsed by all seven experts. Positive comments were provided about items 4 and 5, other items related comments were to do with the length of the question (Table 25).

Table 25 Content validity - Construct 2

Mother's confidence to identify overweight in infancy	
4	Expert 7: I like the way you have worded this question
5	Expert 7: I like the way you have worded this question
6	Expert 1: A bit long and convoluted
7	Expert 1: A bit long and convoluted

9	Expert 7: Questions seem a bit too long.
10	Expert 7: Questions seem a bit too long.

The one general comment made about construct 3 was a very useful one and raised a question about how the items were phrased: “Should you distinguish that these questions are in relation to all infants and not just their own infant?”, suggesting that more clarity about the personalisation of the items was required. 11 out of 15 (73%) of the items (items 3-12, and 14) were endorsed by all the respondents; item specific comments raised an important point about item 15 being double barrelled (Table 26).

Table 26 Content validity - Construct 3

Mother’s perception of infant weight and health risks of infant overweight	
1	Expert 1: Is this clearer without already?
2	Expert 1: Is this clearer without already?
13	Expert 1: Indicates - Bit of an odd word here
15	Expert 1: Item double barrelled - go for either ability to learn or meet developmental milestones? Expert 5: Rather than saying developmentally appropriate would it be better to say your child able to read and write in a way other children of the same age can.

One expert comment on construct 4 highlighted an important point about how the difference in the way that item 2 and item 4 were phrased implied a shift in responsibility when talking about infant feeding, something not initially noted in the development of these items. Overall, 14 out of 19 (74%) of the items were endorsed by all seven experts (items 1, 3, 6-10, 12-15, 17-19)

Table 27 Content validity - Construct 4

Mother’s perceptions of the causes of infant overweight	
2	Expert 1: Interesting that this question is phrased with the baby as actor, whilst the bottle red alternative in Q4 it is the parent who is the actor – this shifts responsibility. Maybe you want to get at this, but if not, consider using fed too much or drink too much for both breast/bottle.
4	Expert 4: Do you need to use bottled and formula milk maybe this is confusing Expert 9: Suggest the words baby milk in place of formula or bottle milk
5	Expert 9: Suggest the words baby milk in place of formula or bottle milk
11	Expert 4: Could you use the word digestion instead of metabolism

16	Expert 4: Maybe change words around so reads ‘overweight babies are just born that way’ Expert 7: I think question is difficult to understand due to ‘not just’ Expert 9: Risk of bias through misunderstanding ‘not’ just

General comments on construct 5 reflected the views of experts on the significance of other emotions experienced by parents, in particular anger. Two of the experts stated; “I find a number of mothers feel let down by services, expecting better and more frequent support and also lots of anger and disappointment as well as guilt” and “could other questions be asked such as I feel angry about not breastfeeding my baby”. In addition, a useful point was made about how concepts of guilt and shame may not be understood by parents. 10 out of 16 (63%) of the items (Items 2-4, 6, 8-10, 14 -16) were endorsed by all seven respondents.

Table 28 Content validity - Construct 5

Mother’s guilt and self-blame in relation to infant overweight	
1	Expert 9: This is quite an emotive question to raise without offering support. Question 2 feels better
5	Expert 5: Just thinking how I would answer this if I wanted to but couldn’t breast feed and feel guilty about that, but would I answer agree or disagree. If disagree, is that because I didn’t choose therefore, I’m not guilty about it or it could mean I did choose and am not guilty.
7	Expert 9: Not sure about the usefulness of this question. A first-time mum will need to learn how to respond to a baby’s cry over time. A second time mum will have a greater insight
11	Expert 9: Readymade baby foods out of a packet, jar etc
12	Expert 1: Use word packet instead of tin Expert 4: Use word packet or bottle instead of tin. Also, how will mums who are using ready to feed bottles answer this question?
13	Expert 1: A bit ambiguous

8 out of 9 of the items (89%), (Items 1-8) were endorsed by all seven respondents; one of the two general comments included the useful suggestion to include an item about judgement from family members.

Table 29 Content validity – Construct 6

Mother's fear of being negatively judged about their infants' weight	
9	Expert 1: Possible for ambiguity as two ideas here? Expert 7: Question is a bit too long.

The expert feedback raised a number of important points regarding the pool of items for each of the constructs. Although for most of the constructs there were no comments made about the majority of the items, amendments to the pilot pool of items was necessary in order to reflect those comments that were made. Comments also indicated that readability and balance of negative and positively worded items could be improved.

5.3.7 Revision of pilot item pool

In light of the expert feedback, some of the original items were revised or deleted and a number of new items added. All changes and addition of new items were done in consultation with the supervisor team (SR and RC). Detail of the changes made are briefly discussed below and resulting pool of items for each construct shown in the above tables. The final pool of items were then subjected to readability tests, assessed for balance of negative and positively worded items and scores assigned, as discussed in more detail below.

Construct 1: Mothers confidence to prevent overfeeding (19 items)

Of the original 18 items, two were unchanged (1 and 2), ten were revised (5-6, 8-15) and six were deleted (3, 4, 7, 16-18) and replaced with seven new items. Many of the changes involved specifying if statement referred to either breast or formula milk and removing some of the negatively worded versions of existing items.

Table 30 Revised item pool (Construct 1)

Item (number of original item)
I am confident that I can feed my baby, so they do not gain too much weight (1)
I am confident that I can feed my baby, so they gain enough weight (2)
I find it difficult to tell whether my baby has had enough breast/formula milk* (5)
I have no concerns about giving my baby less milk* (6)
I find it difficult to resist my baby's demands for milk* (8)
When my baby is crying, I can settle them without giving them a bottle/breast milk (9)

I am not confident about reducing my baby's breast/formula milk until they are on a solid diet* (10)
If my baby was overweight, I would be confident about reducing their breast/formula milk (11)
If my baby was overweight, I would not be confident about reducing their breast/formula milk* (12)
I can tell from my baby cries if they are hungry (13)
I sometimes feed my baby to help them sleep* (14)
I would reduce my baby's food portion if they were becoming overweight (15)
I would not give my baby less breast/formula milk unless my health visitor advised*
I am not sure if my baby should finish all the formula milk in their bottle*
There is little I can do to stop my baby becoming overweight*
I would reduce my baby's food portion size, if they were becoming overweight
I have little control over my baby's weight until they start to eat solid foods*.
I have little control over my baby's diet until they start to eat solid foods*.
I can tell when my baby has had enough breast/formula milk

**denotes negatively worded/reversed scored item, statements in bold indicate a new item.*

Construct 2: Mother's confidence to identify overweight in infancy (17 items)

Of the original 12 items, three were deleted (6, 7 and 10), four were unchanged (4, 5, 11, 12) and five revised (1-3, 8 and 9) and eight new items created. Changes reflected shortening of existing items and the addition of more questions relating to growth charts and the role of the health visitor.

Table 31 Revised item pool (Construct 2)

Item (original item number)
I could tell if my baby was bigger than other babies the same age as them (1)
I could tell if my baby was bigger than their brother or sister was at the same age (2)
I could tell if my baby was overweight or obese (3)
I am unsure if I would be able to tell if my baby was overweight* (4)
I am unsure if I would be able to tell if my baby was obese* (5)

I need the health visitor to help me recognise if my baby was becoming overweight* (8)
The only way to tell if my baby is overweight is by the growth chart in the red book* (9)
It is not possible to tell if my baby is overweight until they start to walk* (11)
My baby's weight is exactly what it should be for their age (12)
I find it reassuring to get my baby's weight checked in clinic*
I don't need to get my baby's weight checked in clinic
I don't need a health visitor to help me see that my baby is becoming overweight
I can see for myself if my baby is overweight
My baby looks bigger than other babies of the same age
I don't trust what the growth charts in the red book tell me about my baby's weight
Only a health professional is qualified to judge if my baby is overweight*
I am unsure what the growth charts in the red book tell me about my baby's weight*

Construct 3: Mother's perceptions of infant weight and health risks of infant overweight (14 items)

Of the original 15 items, three were deleted (1, 2 and 12), items 1 and 2 were deleted as, although not picked up by the experts, these items did not reflect the construct. A further 11 items (3-11, 13-15) items were amended to personalise the statements to relate to their own infant and two new items created.

Table 32 Revised item pool (Construct 3)

Item (number of original item)
My baby being overweight means they may have health problems in the future (3)
My baby being overweight now will not affect their health in the future* (4)
My baby being overweight now will increase the chance they will be overweight as a toddler (5)
It is more likely that my child will be overweight when they are at school if they were overweight as a baby (6)

It is more likely that my child will be an overweight adult if they were overweight as a baby (7)
It only becomes unhealthy for my baby to be overweight when they are old enough to walk* (8)
It only becomes unhealthy for my baby to be overweight when they are at school* (9)
It's only bad for my baby's health if they are very, very big or obese* (10)
It is healthier for my baby to be overweight than underweight* (11)
My baby's' weight is less important to me than whether they are happy and content* (13)
Being overweight could make it more difficult for my baby to start walking (14)
Being overweight may affect my baby's ability to learn (15)
My baby being overweight as a toddler is bad for their health in the future
My baby's future chance of being overweight is higher if they are overweight now.

Construct 4: Mother's perceptions of the causes of overweight in infants (16 items)

Of the original 19 items, five were deleted (item 3,5,12, 17 and 18) primarily because they were repeats of existing items, just negatively worded. Eight remained unchanged (7-9,11,13, 14,16 and 19) and six were revised to make the language simpler or clearer (1,2,4,6,10 and 15).

Table 33 Revised item pool (Construct 4)

Behavioural (Internal causal attribution)
Babies become overweight because they don't move around enough until they start walking (1)
Babies become overweight because they are fed too much breast milk (2)
Babies become overweight because they are fed too much formula milk (4)
Babies cannot become overweight when they are only being fed on a milk (6)
Biological (Internal causal attribution)
A baby is more likely to become overweight if its biological mother is overweight (7)

A baby is more likely to become overweight if its biological father is overweight (8)
Some babies become overweight because they are hungrier than other babies (9)
Some babies become overweight because they have slow digestion* (10)
Some babies become overweight due to a medical condition* (11)
Baby boys are less likely to become overweight than baby girls* (13)
A baby's weight is not influenced by its parents' weight* (14)
A baby's weight has nothing to do with genes (15)
Overweight babies are not just born that way* (16)
Maternal perceptions of controllability /perceived personal control
There is nothing that parents can do to prevent their baby becoming overweight* (19)
If a baby is hungry it must be fed regardless of its weight*
If a baby is fed correctly it will not become overweight

Construct 5: Mother's guilt and self-blame in relation to infant overweight and guilt associated with reducing milk feeds (16 items)

Of the original 16 items, there were a number of changes made to this pool of items. Seven were deleted (2-6). This was due to their failure to capture the original qualitative study findings, given that the aim of this construct in relation to feeding was to measure guilt around reducing milk feeds and their infant's weight, not about not being able or choosing not to breastfeed. The seven revised items were to improve clarity and improve the balance of negative and positive items (7, 9-12, 14 and 15). Two items were unchanged (1and13),

Table 34 Revised item pool (Construct 5)

Item (number of original item)
I feel guilty about using formula rather than breast milk to feed my baby (1)
I feel guilty that I feed my baby as a way to keep them quiet (7)
Not offering my baby breast/formula milk when they were crying would make me feel like a bad mum (9)
I would feel comfortable about reducing my baby's food portions* (10)
I feel guilty about using readymade baby foods (11)

I would feel guilty if I gave my baby less formula milk than the packet says I should (12)
I often feel guilty about the way I feed my baby (13)
I don't feel guilty about my baby's weight* (14)
I do not blame myself if my baby's weight* (15)
I don't feel guilty for using readymade baby foods*
I would blame myself if my baby was overweight when they were older
I would feel like a bad mum if I gave my baby less breast/formula milk
I would feel guilty about giving my baby less breast/formula milk
I would feel guilty if my baby's weight was increasing their chance of being overweight in the future
Because of my baby's weight, I regret feeding them the way I do
Because of my own weight, I feel to blame for my baby's weight

Construct 6: Mother's fear negative judgement about their infant's weight (13 items)

Three items remained unchanged (1,3 and 8), two items were deleted (5 and 9), four were revised (2,4,6 and 7) and six new items were added.

Table 35 Revised item pool (Construct 6)

Item (number of original item)
I feel comfortable with the way my baby looks* (1)
I don't care what other people think of my baby's weight* (2)
I feel tense when it is obvious that people are looking at my baby (3)
I am concerned about what will say about me because of my baby's weight (4)
I worry that other mothers talk about my baby's weight (6)
I am concerned what the health visitor thinks about my baby's weight (7)
I am concerned that people will think I am a bad mother because of my baby's weight (8)
I am concerned my baby's weight makes me look like a bad mother
I feel embarrassed when I take my baby to be weighed
I worry that the health visitor thinks I am a bad mother because of my baby's weight
It doesn't worry me what the health visitor says about my baby's weight*

I am uncomfortable about taking my baby out because of what people may think about their weight
It worries me what my family thinks about my baby's weight

Following the revisions made to the items, the acquiescence bias and readability were tested.

Acquiescence bias

The final pool of items for constructs 1-4 had a balance of negative and positively worded items, however construct 5 and 6 had a higher number of positively worded items, suggesting that there could be an element of acquiescence bias, the tendency for a respondent to agree rather than disagree to questioning (Oppenheim, 1992).

Readability

Results shown in Table 36 indicate that four out of six of the constructs had acceptable levels of readability; however, a score of 41 for construct four indicates that this was considered as difficult. To aid interpretation, Flesch reading scores were converted into a corresponding Flesch-Kincaid Grade, so that completing the questionnaire would not require reading skills beyond that of a 12-year-old to avoid missing values and unreliable answers (Streiner, 2003). This is equivalent of Flesch-Kincaid 6th Grade, which is school year seven in the UK (students 11-12yrs).

Table 36 Scale readability

	Flesch Reading Ease (FRE)	Flesch-Kincaid Grade Level
Construct 1 – Self-efficacy to prevent overfeeding	73.1	6.7
Construct 2 – Self-efficacy to identify overweight	0	0
Construct 3 – Risk perception	74	7.6
Construct 4 - Causes of overweight in infancy	41	10.8
Construct 5 – Guilt and shame	83	4.9
Construct 6 – Fear of negative evaluation/	0	0

Each of the items designed to measure each of the constructs demonstrated good content validity, readability, and a reasonable balance of negatively and positively worded items. The next chapter will go on to assess the items using factor analysis in

order to establish the internal structure of the scale items and their consistency, with the aim of measuring each of the constructs that the scale is intended to measure.

Chapter Six
Study Two: Exploratory and Confirmatory Factor Analysis of Parental Engagement in the Obesity Prevention Scale (PEOPS)

6.1 Introduction

This chapter describes the processes undertaken to develop a new scale to measure Parental Engagement in Obesity Prevention (PEOP), to examine and confirm its factor structure and assess its psychometric properties. The rationale for the development of this new scale was to understand more about the factors that may either predict or present barriers for engaging parents in efforts to prevent childhood obesity. In particular, the research seeks to understand how receptive parents of infants are to professional assessment of their infants' future risk of becoming overweight. The more that is understood about perceptions of parents on early obesity interventions such as this one, the more that can be done to minimise existing barriers. Development of the scale was informed by the qualitative findings of study one, other existing literature and theory. This resulted in six hypothetical concepts of parental engagement: self-efficacy to prevent overfeeding/influence weight through feeding; guilt/self-blame about infant overweight and guilt associated with reducing milk/food; self-efficacy to identify infant overweight; fear of negative evaluation/judgement about infant overweight; perception of health and other related risks of overweight and obesity in infancy; and causal attributions of infant overweight. This chapter discusses the next phase of scale development, in which factor analysis was performed upon two different datasets. The initial analysis consisted of an exploratory factor analysis within a cohort of 282 participants, which identifies the scales factor structure. This was followed by a confirmatory factor analysis within a second cohort of 446 participants to confirm the factor structure and psychometric properties of the new scale.

6.2 Introduction to the Common Factor Model - Factor Analysis

Factor analysis is a multivariate statistical approach commonly used in the psychometric evaluation of multiple item scales (Cudeck and MacCallum, 2007). Factor analysis procedures include exploratory factor analysis (EFA) and confirmatory factor analysis. Factor analysis is commonly used in the field of psychology to explain the relationship between observed and unobserved or latent variables, known as factors (Thurstone,

1947). An unobserved or latent variable is something that cannot be directly observed, such as a human belief or attitude and its measurement is therefore inferred from other variables that can be observed. Factor analysis has several purposes: firstly, introduces a larger number of observed variables, such as items on a questionnaire, to a smaller, more meaningful set of items. Secondly, it ascertains the underlying dimensions between the latent and observed variables, allowing the development and refinement of theory. Thirdly, it provides evidence of construct validity (Thompson, 2004). When developing a new scale such as the PEOPS, factor analysis is used to demonstrate that the internal structure, or dimensionality, of the scale items are consistent with the expectation regarding the latent constructs that the scale is intending to measure.

EFA followed by CFA is one of the most common approaches to scale development (Worthington and Whittaker, 2006) and is the one utilised for this project. Once the underlying factor structure is established using EFA and a final item pool is determined, CFA is then utilised to evaluate, or theory test the structure (Costello and Osborne, 2005). CFA is used to assess how well the hypothesised factor structure, developed from the EFA, "fits" the observed data (Brown, 2015) and requires a conceptual foundation. Fierce debate exists around whether to use EFA or principal components analysis (PCA), another procedure of factor analysis for scale development. Devellis (2012) argues that PCA is unsuitable for scale development as it simply seeks to reduce a large number of variables to a smaller set, without making theoretical assumptions about the relationship between the observed and latent variables. Given that parental engagement is an unobserved psychological concept, or latent variable, exploratory factor analysis was chosen as the most appropriate method for the development of the PEOP scale (Schmitt, 2011).

6.3 Exploratory Factor Analysis Study Procedure

6.3.1 Sample

A convenience sample of 546 parents of infants were recruited between 12th April 2016 and 23rd May 2016. Parents were recruited if they had an infant of 12 months or younger, were over 18 years of age and living in the UK.

6.3.2 Sampling and Sample Size

Participants were recruited from the from The Baby Centre website (www.babycentre.co.uk). In order to obtain a representative sample of the population of mothers with appropriately aged infants, existing online community groups were

targeted (Table 37). An introduction to the study inviting parents to participate was posted on the website, providing a link to the Qualtrics survey,Appendix H.

Table 37 Online community groups (Baby Centre)

Group Name (no of members)	Age of children in group (start of data collection)
Feeding and weaning (7593)	All ages
What's your opinion on (13,709)	All ages
July 2015 birth group	9-10 months
October 2015 birth group	6-7 months
November 2015 birth group	5-6 months
December 2015 Birth Group (6249)	4 -5 months

6.3.3 Ethical Considerations

The study was conducted in accordance with the ethical principles that have their origin in the Declaration of Helsinki, 1996; the principles of Good Clinical Practice and the Department of Health Research Governance Framework for Health and Social care, 2005. Ethical approval from Anglia Ruskin, Faculty of Health Social Care and Education, Research Ethics Panel (DREP) SNM/DREP/15-007 was provided on 18.2.16. Appendix I. Consent to post a link to the survey on the Baby Centre Website was provided by the social media manager. Consent from individual participants was sought at the start of the study through a forced response binary question. Those who did not consent were automatically directed to the end of the survey. Consenting participants were asked to provide a password as the personal identifier so in the event that they decided to withdraw at any point, their response could be identified.

6.3.4 Sample size adequacy and handling of missing data

The optimum sample size required for factor analysis is debated within the literature (Hogarty, et al. 2005). Cited rules of thumb range between a sample of n=100 or greater as a minimum (Hair et al 1995, Kline 1993), 200 if there are no more than 40 items (Comrey, 2013) or at least 300 (Tabachnick and Fidell, 2007). Worthington and Whittaker (2006) suggest that this guidance can be misleading and that in the case of a high sample to variable ratio (N:p ratio) with high commonalities, smaller numbers will suffice. For this study, a sample of 300 was considered as the minimum.

Participants who stopped completing the questionnaire after the demographic questions, i.e. those with 100% of missing data in relation to the 95 scale items, were excluded from all further analysis. In order to ascertain the remaining level of missing data, Little's Missing Completely at Random (MCAR) test (Little, 1988) was performed. A non-significant Littles test ($p<.05$) indicates that cases are not missing completely at random, highlighting some systematic bias potentially caused by a particular scale item. To prevent bias, cases with data Missing Not at Random (MNAR) were deleted from the data set. Data MCAR was replaced using multiple imputation (MI) (Rubin, 1987), this imputation method was chosen above simpler methods such as mean or regression imputation, to prevent underestimates of variances and overestimates of correlations among variables with imputed data (Brown, 2015).

6.3.5 Data collection procedures and instruments

The final item pool had 95 items falling within the six theorised subscales (Table 38). Subscales were set up as separate question blocks within the survey and items within the blocks were randomised. A seven-point Likert scale with response options of strongly agree, agree, somewhat agree, neither agree nor disagree, somewhat disagree, disagree, and strongly disagree was utilised. Qualtrics research software hosted the questions, collected the participant responses (www.qualtrics.com) and collected data exported into SPSS (Version 24) for analysis. Prior to seeing the scale items, participants were asked to complete demographic information about themselves and their infant, as well as a few single response items relating to risk communication and parent perception of their infant's weight.

Table 38 Item Pool (95 items)

Construct 1: Maternal self-efficacy for preventing overfeeding /influencing weight through feeding (Feeding Your Baby - 19 Items)	
1	I am confident that I can feed my baby, so they do not gain too much weight
2	I am confident that I can feed my baby, so they gain enough weight
3	I would not give my baby less breast/formula milk unless my health visitor advised me to
4	I am not sure if my baby should finish all the formula milk in their bottle
5	I find it difficult to tell if my baby has had enough breast/formula milk
6	I have no concerns about giving my baby less breast/formula milk
7	There is little I can do to stop my baby becoming overweight
8	**I find it difficult to resist my babies demands for breast/formula milk**

9	When my baby is crying, I can settle them without giving them a breast milk/bottle
10	**When my baby cries it is difficult to calm them down without giving them breast/formula milk**
11	I am not confident about reducing my baby's breast/formula milk until they are on a solid diet
12	If my baby was overweight, I would be confident about reducing their breast/formula milk
13	If my baby was overweight, I would not be confident to reduce their breast/formula milk
14	**I sometimes feed my baby to help them sleep**
15	I can tell from the way my baby cries if they are hungry
16	I would reduce my baby's food portion size, if they were becoming overweight
17	I have little control over my baby's weight until they start to eat solid foods.
18	I have little control over my baby's diet until they start to eat solid foods.
19	I can tell when my baby has had enough breast/formula milk
Construct 2: Maternal guilt/self-blame about infant overweight and guilt associated with reducing milk/food (Feelings about your baby's diet and weight - 16 Items)	
20	*I feel guilty about using formula rather than breast milk to feed my baby
21	I feel bad about feeding my baby as a way to keep them quiet
22	Not offering my baby breast milk/formula milk when they were crying would make me feel like a bad mum
23	I feel guilty about using readymade baby foods
24	*I don't feel guilty about using readymade baby foods
25	*I would feel guilty about giving my baby less formula milk than the packet says I should
26	I often feel guilty about the way I feed my baby
27	I would blame myself if my baby was overweight when they were older
28	I don't feel guilty about my baby's weight
29	I do not blame myself for my baby's weight
30	**I would feel like a bad mum if I gave my baby less breast/formula milk**
31	**I would feel guilty about giving my baby less breast/formula milk**
32	I would feel guilty if my baby's weight was increasing their chance of being overweight in the future

33	*I would feel comfortable about reducing my baby's food portions
34	Because of my baby's weight, I regret feeding them the way I do.
35	Because of my own weight, I feel to blame for my baby's weight
Construct 3: Maternal self-efficacy for identifying infant overweight (Your baby's weight - 17 Items)	
36	I could tell if my baby was bigger than other babies the same age as them
37	* I could tell if my baby was bigger than their brother or sister was at the same age
38	I could tell if my baby was overweight or obese
39	**I am unsure I would be able to tell if my baby was overweight**
40	**I am unsure I would be able to tell if my baby was obese**
41	**I need the health visitor to help me recognise if my baby was becoming overweight**
42	The only way to tell if my baby is overweight is by the growth chart in the red book
43	It is not possible to tell if my baby is overweight until they are walking
44	I find it reassuring to get my baby's weight checked in clinic
45	I don't need to get my baby's weight checked in clinic
46	I don't need a health visitor to help me see that my baby is becoming overweight
47	My baby's weight is exactly what it should be for their age
48	I can see for myself if my baby is overweight
49	My baby looks bigger than other babies of the same age
50	I don't trust what the growth charts in the red book tell me about my baby's weight
51	Only a health professional is qualified to judge if my baby is overweight
52	I am unsure what the growth charts in the red book tell me about my baby's weight
Construct 4: Maternal fear of judgement (What others think about your baby's weight - 13 Items)	
53	I am comfortable with the way my baby looks
54	I don't care what other people think about my baby's weight
55	**I feel tense when it is obvious that people are looking at my baby**
56	**I am concerned what people will say about me because of my baby's weight**

57	**I am concerned my baby's weight makes me look like a bad mother**
58	**I worry that other mothers talk about my baby's weight**
59	I am concerned what the health visitor thinks about my babies weight
60	**I am concerned that people will think I am a bad mother because of my baby's weight**
61	I feel embarrassed when I take my baby to be weighed
62	**I worry that the health visitor thinks I am a bad mother because of my baby's weight**
63	It doesn't worry me what the health visitor says about my baby's weight
64	I am uncomfortable about taking my baby out because of what people may think about their weight
65	It worries me what my family thinks about my baby's weight
Construct 5: Maternal perception of health and other related risks of obesity (Weight and health 14 items)	
66	**My baby being overweight as a toddler is bad for their health in the future**
67	It's only bad for my baby's health if they are very, very big or obese
68	**My baby being overweight means they may have health problems in the future**
69	My baby being overweight now will not affect their health in the future
70	**My baby being overweight now will increase the chance they will be overweight as a toddler.**
71	It only becomes unhealthy for my baby to be overweight when they are at school
72	**It is more likely that my child will be overweight when they are at school if they were overweight as a baby.**
73	It is more likely that my child will be an overweight adult if they were overweight as a baby
74	Being overweight could make it more difficult for my baby to start walking
75	Being overweight may affect my baby's ability to learn
76	**My baby's future chance of being overweight is higher if they are overweight now**
77	It only becomes unhealthy for my baby to be overweight when they are old enough to walk
78	It is healthier for my baby's to be overweight than underweight

79	My baby's weight is less important to me than whether they are happy and content
Construct 6: Maternal perception of causal attributions for infant weight (locus of causality) (Reasons babies become overweight - 16 Items)	
80	Babies become overweight because they don't move around enough until they start walking
81	Babies become overweight because they are fed too much breast milk
82	There is nothing that parents can do to prevent their baby becoming overweight
83	Babies become overweight because they are fed too much formula milk
84	Babies cannot become overweight when they are only being fed on milk
85	If a baby is hungry it must be fed regardless of its weight
86	A baby is more likely to become overweight if its biological mother is overweight.
87	A baby is more likely to become overweight if its biological father is overweight.
88	Some babies become overweight because they are hungrier than other babies are.
89	Some babies become overweight because they have slow digestion
90	Some babies become overweight due to a medical condition
91	If a baby is fed correctly, it will not become overweight
92	Baby boys are less likely to become overweight than baby girl
93	A baby's weight is not influenced by its parents' weight
94	A baby's weight has nothing to do with genes
95	Overweight babies are just born that way

*NB. Items in bold are those that survived exploratory factor analysis (19). * Items lost to human error in set up of Qualtrics survey flow (6.4.2)*

6.3.6 Preliminary Analysis – Assessment of Data Suitability and Assumptions of EFA

Prior to factor analysis, suitability of the data was assessed to ensure it met the assumptions of factor analysis; this included adequacy of the sample size (discussed above), factorability of the correlation matrix and sampling adequacy measures (Williams, Onsman and Brown, 2010). Factorability, or degree of correlation between individual variables was assessed using the correlation matrix. The matrix was inspected for Pearson correlation coefficients of + 0.50, defined as practically significant (Hair, et al. 1995). Any variables not correlating with any other variable with a correlation

of ± 0.50, were removed. Finally, the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy and Bartlett's Test of Sphericity were performed (Kaiser, 1970). The KMO of all variables together and individual variables was inspected: 0.5 was taken as the minimum score suitable for factor analysis (Kaiser and Rice, 1974) and a significant ($p<.05$) Bartlett's test. Although normality is not an assumption of factor analysis, univariate and multivariate normality were also assessed. An absolute skew value > 2 and a kurtosis of >7 were seen as substantial departures from normality (West, Finch and Curran, 1995).

6.3.7 Exploratory Factor Analysis Procedures

Three key steps of exploratory factor analysis were performed: factor extraction, rotation and interpretation. The goal of extraction is to reduce a large number of items into factors to provide an optimal way of assessing the factors with the fewest number of items. Various factor extraction methods are utilised in factor analysis, the most common of which are Principal Components Analysis (PCA) and Principal Axis Factoring (PAF) (Pett, 2003). The merits of each method are debated, although the practical differences between them are thought to be insignificant (Thompson, 2004). For this study, PAF was the chosen method. Several criteria exist to inform the number of factors to retain, which include the Scree test (Cattell, 1966), Kaiser's criteria (selecting all factors with an eigenvalue >1) (Kaiser 1960), parallel analysis and cumulative percent of variance extracted (Horn, 1965). Given the complex nature of factor analysis, the use of only one criterion is not recommended (Costello and Osborne, 2005). For this study the Scree test, Kaiser's criteria (eigenvalue >1 rule) and cumulative percent of variance extracted were used.

Following extraction, rotation was performed. Rotating factors maximises high item loadings and minimises low item loadings, making them more interpretable and providing a simplified solution (Wiiliams, Onsman and Brown, 2010). This is also useful in assessing if a particular variable may relate to more than one factor. The two most common rotations are orthogonal varimax/quartimax and oblique olbimin/promax. The main difference between the two is that orthogonal rotations produce factors that are uncorrelated whereas oblique rotations produce correlated factors. Traditionally, Orthogonal Varimax rotation is the most commonly used rotation technique (Thompson, 2004). However, for this analysis, oblique rotation was considered the most appropriate, due to its accuracy in research involving human behaviours (Costello and Osborne, 2005) and the anticipated degree of correlation between the factors measuring

engagement. For completion, both methods of oblique rotation (Promax and Direct Oblimin) were performed in order to identify the rotated solution that provides the easiest to interpret fit and factorial suitability. In order to reduce the total number of items, following rotation, the item loading tables were compared and reviewed for items loading on several factors (cross loading) or those not loading onto any factor. All items with a factor loading below <.50. or cross loading items with values of >.32 on at least two factors, were deleted (Costello and Osborne, 2005). Following deletion of items, the EFA was rerun until the final solution was achieved. In addition, items that could be deleted without a negative impact upon the internal consistency of the total scale or subscales, were removed. A minimum of between three and five items per factor were retained to ensure meaningful interpretation of the factor and scale (Hogarty, et al. 2005; Raubenheimer, 2004). In order to interpret the findings, the final pattern matrix was reviewed to see which of the variables were attributable to the retained factors. The content of the grouped variables were examined and each of the factors was descriptively labelled to reflect the concept.

6.3.8 Reliability

Internal consistency reliability of the scale was assessed using Cronbach's coefficient alpha estimates. (Cronbach, 1951). A criterion of between 0.70 and 0.95 demonstrates good internal consistency in a new scale and was the criteria used for this study (Nunally and Bernstein, 1994).

6.4 Results

6.4.1 Participants (Sample one)

A total of 528 of individuals were eligible and consented to participate in the study (97% of the original sample of 546). Mothers' responses to demographic questions about themselves and their infants is shown below in Table 39.

Table 39 Mother and infant characteristics (Study Two - Sample One)

Mothers Characteristics	
Age in years n=465	n (%)
Under 20	2 (0.4)
20-24	38 (8.2)
25-29	150 (32.3)
30-34	181 (38.9)

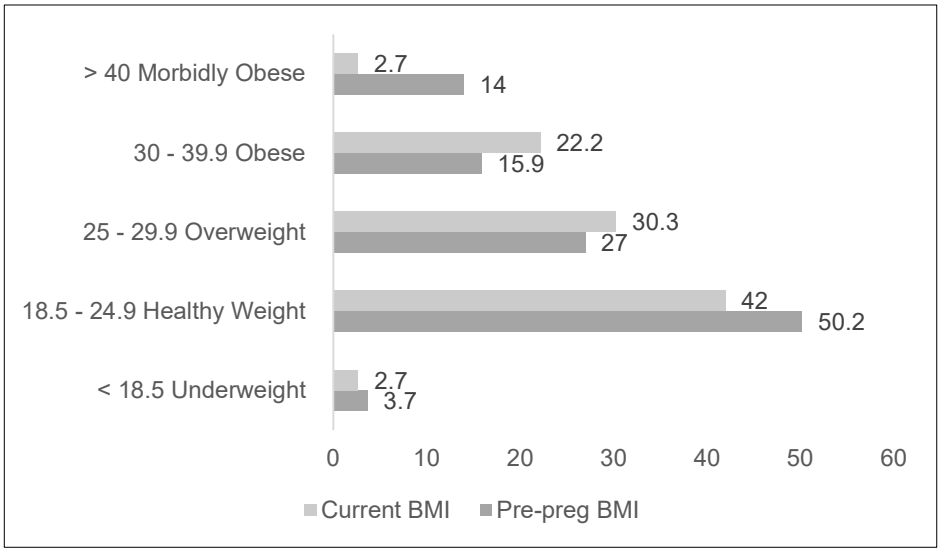
35-39	79 (17)
40-44	14 (3)
45-49	1 (0.4)
First time mother n=434	
Yes	260 (60)
No	174 (40)
Ethnicity n=460	
White	
English/Welsh/Scottish/Northern Irish/British	408 (88.7)
Irish British	11 (2.4)
Any other White background	12 (2.4)
Mixed/Multiple ethnic groups	
White and Black Caribbean	4 (.9)
White and Black African	4 (.9)
White and Asian	1 (.2)
Any other Mixed/Multiple ethnic	6 (1.3)
Asian/Asian British	
Indian	6 (1.3)
Pakistani	1 (.2)
Any other Asian background	1 (.2)
Black/ African/Caribbean/Black British	
African	3 (.7)
Caribbean	3 (.7)
Education: n=458	
No formal qualifications	2 (0.4)
GCSEs or equivalent	38 (8.3)
A Levels or equivalent	90 (19.7)
Undergraduate Degree	188 (41)
Postgraduate Degree	140 (30.6)
Employment status: n=459	
Employed	368 (80.2)
Unemployed	73 (15.9)
Self-employed	18 (3.9)
Smoking status during pregnancy, n=461	
No	432 (93.7)
Yes	29 (6.2)

Maternal Height n=459	
Range	145cm (4ft9) – 188cm (6ft2)
Mean	165cm (5ft5)
Pre-pregnancy weight n=451	
Range	40.37kg (6st 5lb) – 137.08kg (21st6lb)
Mean	70.18kg (11st3lb)
Pre-pregnancy BMI n=434	
Range	15kg/m^2 - 50.7kg/m^2
Mean	25.87 kg/m^2
< 18.5 Underweight	16 (3.7)
18.5 - 24.9 Healthy Weight	218 (50.2)
25 - 29.9 Overweight	117 (27)
30 - 39.9 Obese	69 (15.9)
> 40 Morbidly Obese	14 (3.2)
Maternal Weight, n=456	
Range	39.46kg (6st 5lb) – 142.4kg (22st 6lb)
Mean	73.18kg (11st 8lb)
Maternal BMI, n=445	
Range	15.4kg/m^2 - 48.3kg/m^2
Mean	26.8kg/m^2
< 18.5 Underweight	12 (2.7)
18.5 - 24.9 Healthy Wt	187 (42)
25 - 29.9 Overweight	135 (30.3)
30 - 39.9 Obese	99 (22.2)
> 40 Morbidly Obese	12.0 (2.7)
Infant Characteristics	
Gender, n=432	n (%)
Male	221 (51)
Female	211 (49)
Age, (n=432)	
12 weeks and under	18 (4.2)
13 – 26 weeks	199 (46)
27 – 39 weeks	141 (32.6)
40 – 52 weeks	74 (17.1)
Birthweight, n=432	
1.95kg and below	7 (1.6)

2-2.95kg	77 (17.4)
3-3.95kg	268 (62)
4-4.95kg	75 (17.4)
Last known weight centile, n=402	
<10th percentile	52 (12.9)
10th to 25th	52 (12.9)
25th to 50th	94 (23.4)
50th to 75th	89 (22.1)
75th to 90th	54 (13.4)
Above the 90th	52 (12.9)
Not known	9 (2.2)
Current method of Feeding, n=402	
Formula fed	179 (44.5)
Breastfed	186 (46.3)
Mixed feeding	37 (9.2)
Infants ever breastfeed, n=405	
Yes	363 (89.6)
No	42 (10.4)
Months of exclusive breastfeeding, n=358	
Not at all	8 (2.2)
1 week or less	66 (18.4)
4 weeks of less	39 910.9)
8 weeks or less	25 (7)
12 weeks or less	9 (2.5)
16 weeks of less	17 (4.7)
20 weeks or less	34 (9.5)
24 weeks or less	47 (13.1)
6 months or over	77 (21.5)
Between 6 -12 months	36 (10.1)
Age solid foods introduced, n=256	
Around 3 months old	5 (2)
Around 4 months old	20 (7.8)
Around 5 months old	77 (30.1)
Around 6 months old	144 (56.3)
Older than 6 months	10 (3.9)

All participants were female, the majority were between 30-34 years of age (38.9%, n=181) and were first time mothers (60%, n=260). Most were of English/Welsh/Scottish/Northern Irish ethnicity (88.7%, n= 408), educated to degree level or above (71.6%, n=328) and employed prior to pregnancy (80.2%, n=368). Most mothers had never smoked during pregnancy (93.7%, n=432). Current and pre-pregnancy body mass index (BMI) indicated that 46.1% of mothers were overweight or obese prior to pregnancy, increasing to 55.2% after pregnancy (Figure 3). Data on occupation, paternal height and weight was also collected and is available upon request. Mothers were also asked how they perceived their child's weight, from options including much to low/ too low/just right etc. Given that it was decided that assessing accurate parental perception of infant weight was beyond the remit of this study, the results are not presented but are available on request.

Figure 3 Maternal pre-pregnancy and current BMI

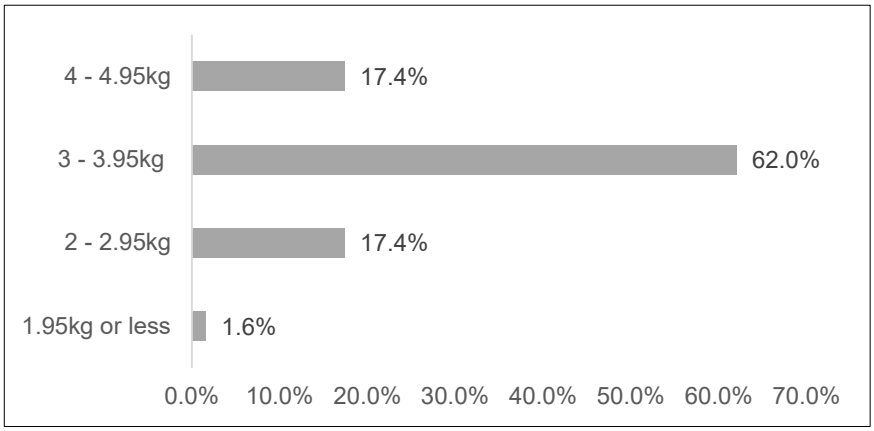


Just over half of the infant sample were male (51%, n=221). The majority of infants had a birth weight ranging between 3- 3.95kg (62%, n=268) (Figure 4).

Data collected on feeding identified that a high number of infants had been breastfed for some period of time (89.6%, n=363) while only a fifth had been breast fed exclusively for six months (21.5%, n=77) (Figure 5). At the time of data collection, a similar percentage of mothers described their current method of infant feeding as breastfeeding (46.3%,

n=186) and formula feeding (44.5%, n=179). The majority of infants were weaned at around six months (56.3%, n=144).

Figure 4 Infant birth weight



In addition to the demographic questions, mothers were asked about their preferences towards receiving information about their infants' future risk of becoming overweight. Over fifty percent of mothers indicated that they would want to be given information about future risk (Figure 6).

Figure 5 Months of exclusive breastfeeding

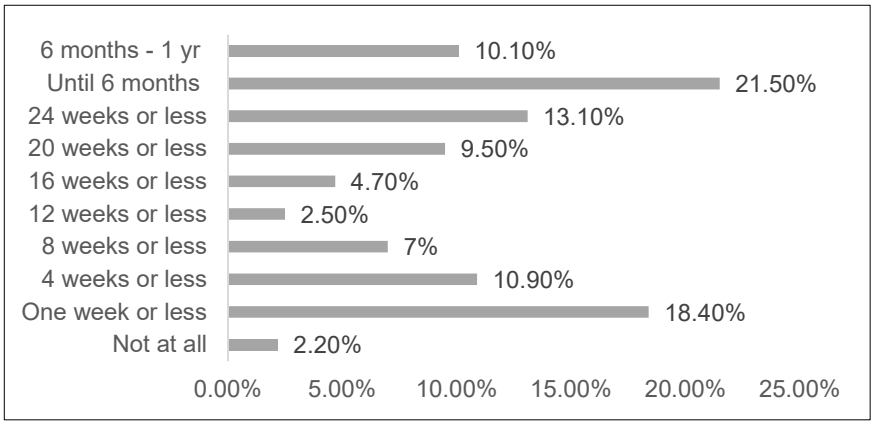
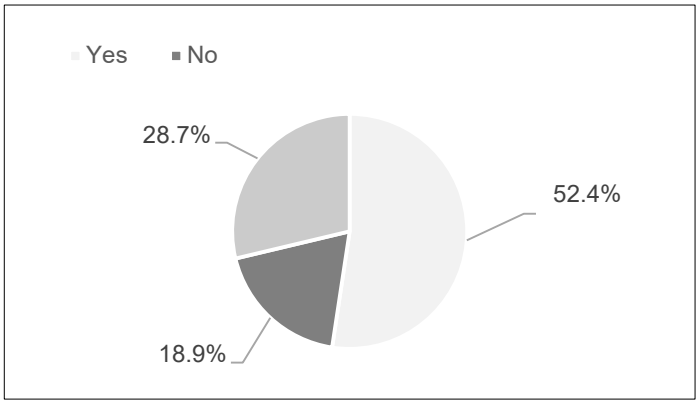


Figure 6 Parent response to question about obesity risk assessment If it was possible for your health visitor to work out your baby's chance of becoming overweight in the future would you want to know this information?



Preference on when they would want to be given this information varied (Table 40) whereas the overwhelming majority stated that they would like to receive the information via a face to face conversation (84% n= 216).

Table 40 Parent preference for timing of obesity risk assessment

When would you want to know about risk? n=257	**n (%)**
At birth	16 (6.2)
Between birth and 1 week	1 (0.4)
Around 1 months old	8 (3.1)
Around 2 months old	2 (0.8)
Around 3 months old	10 (3.9)
Around 4 months old	7 (2.7)
Around 5 months old	3 (1.2)
Around 6 months old	27 (10.5)
Between 6-12 months	63 (24.5)
Between 12-18 months	49 (19.1)
Between 18-24 months	20 (7.8)
2 years or older	51 (19.8)
How would you want the information n=257	
Face to face	216 (84)
Letter	40 (15.6)
Phone call	1 (0.4)

Seventy-five of the participants (14.2%) responded to a voluntary option to add any free text at the end of the survey. The comments were reviewed by the interviewer and a

member of the supervisor team (SR) and were grouped based on the main areas of feedback below. A full version of the comments is available on request if required.

- The omission of a question about infant length in the questionnaire.
- Criticism of questionnaires, negatively worded/tone of – abstract implication of blame.
- Belief that babies cannot be overweight - Belief that breastfed babies cannot be overfed.
- View from some that genetics or family history have a strong role in infant size and growth.
- Uncertainty about the growth charts/system used by health visitors to measure growth.
- More concern about underweight.
- Judgement from others.

6.4.2 Sample size adequacy and handling of missing data

A total sample of 528 consented and were eligible to take part in the study. Those who did not progress beyond the demographic questions or did not attempt to start all the six blocks of questions, were excluded (139). An additional 37 cases who selected the 'mixed feeding option' had to be deleted due to human error in the set up of the Qualtrics survey flow. This resulted in a sample of 352 (53%) for inclusion in the factor analysis. Only cases who had started and answered any items within each of the six subscale blocks, were included.

A Little's MCAR test performed on the remaining 352 cases was significant ($p<.05$), suggesting that missing data was not random (MNAR). This is most likely explained by participant fatigue related to survey attrition (Table 41) as opposed to an issue with a particular item. On inspection of the items, missing data ranged between 14-24% and increased as the survey progressed. Using methods to replace missing data of this level is likely to result in a larger bias than the analysis of a complete data set missing data across the subscales. Therefore, a decision was taken not to replace the missing data, leaving a data set of 282. A further Little's test was performed on the 282 cases, which identified less than 1.1% of missing data remained within the subscales. This was non-significant, and therefore missing at random (MAR) so was replaced using multiple imputation.

Table 41 Attritions rates

Constructs in order of appearance within survey and name provided for participants	Lost (N)	Remaining (N)
1 - Maternal self-efficacy to prevent overfeeding/influence weight through feeding (Feeding your baby)	0	**352**
2 - Maternal guilt and self-blame in relation to infant weight and guilt associated with reducing milk/food (Feelings about your baby's diet and weight)	11	341
3 - Maternal self-efficacy to identify infant overweight (Your baby's weight)	21	331
4 - Maternal fear of judgement (What others think about your baby's weight)	35	317
5 - Maternal perception of health and other related risks of obesity (Weight and health)	54	298
6 - Maternal perception of causal attributions for infant weight (locus of causality) (Reasons babies become overweight)	70	282

6.4.3 Data suitability to meet assumptions of EFA

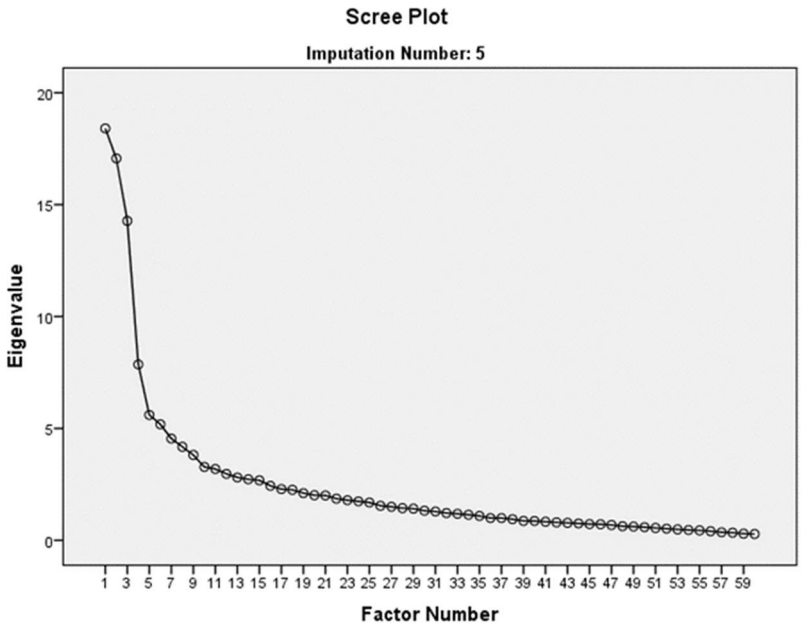
As discussed in section 6.3.7, several methods were used to assess the suitability of the data for factor analysis. Skewness ranged between -3.022 (SE = 0.14; Item 64) and 3.22 (SE = 0.14; Item 53) and Kurtosis ranged between 11.196 (SE = 0.290 Item 64) and -1.353 (SE = 0.290; item 51), suggesting most items had considerable levels of skewness and kurtosis (West, Finch and Curran 1995). Items were also subjected to the Kolmogorov-Smirnov test which was significant (<0.5) for all items, indicating that scores are significantly different from normal distribution, and a non-normal distribution. Normality is not an assumption of exploratory factor analysis and the principle axis factoring method used within this study, is recommended as the best when normality is violated (Fabrigar, et al.1999). Commonalities were greater than 0.5, suggesting that a sample size of 150-200 is adequate (Williams, Onsman and Brown, 2010). The 90 variables had a Kaiser- Meyer-Olkin (KMO) = 0.773, defined as 'good' (Hutcheson and Sofroniou, 1999) and verifying it as adequate for factor analysis. The Bartlett's test of sphericity [χ^2] (281) = 11151.765, p<0.001 also indicated that the correlations between items were sufficiently large for exploratory factor analysis. The KMO of individual items were also examined and those <.5 were deleted (Items 37, 90 and 94). Factorability of

the correlation matrix was then inspected and 13 items with any variables with a Pearson correlation coefficient of less than ±0.30 (12 items) or those correlating with one other variable at ±.30 (15 items), were deleted, resulting in 60 remaining variables for factor analysis.

6.4.4 Exploratory Factor Analysis

Exploratory factor analysis was performed on the remaining 60 items. An initial analysis was run to obtain the eigenvalues for each of the components, 15 had values above Kaiser's criterion of 1 and explained 54.30% of the variance. Kaiser's criterion of 1 is considered more accurate when there are less than 30 variables and commonalities (after extraction) are > 0.7. In this case, the majority of commonalities (after extraction) were less than 0.7. Therefore, the Scree plot, rather than the eigenvalue, was used to inform the decision on how many factors to retain within the final analysis. The point of inflexion of the Scree plot (Figure 7) suggested the retention of four factors.

Figure 7 Scree Plot of 60 items



The scree plot suggested the retention of four factors but because there were originally six original hypothesised constructs for completion, a five-factor rotated (Promax) solution was also performed. This resulted in three items (86,87 and 89) from construct six, causal attributions for infant weight loading onto a fifth factor. For meaningful interpretation, a minimum of three items per latent factor is recommended (Raubenheimer, 2004). In view of this, three items were considered too few and a four-

factor model was considered as the most stable solution. The decision not to include this construct was also supported by the theoretical framework of the thesis.

Both Direct Oblimin and Promax, oblique rotation techniques were performed and Promax rotation was utilised for the final analysis, as it provided the clearest solution. Following rotation inspection of the pattern matrix identified six items for deletion due to a factor loading of below 0.50. There were no cross-loading items for deletion. After deletion of the six items, the EFA was rerun on the 54-item scale. This then identified a further 24 items with factor loading scores of less than 0.5, which were deleted. A final iteration of the analysis on the 30-item scale identified one final item with a factor loading below 0.5 which was deleted, resulting in a 29 item, four factor solution. In order to ensure an even spread of items across the four factors, items from factor one were deleted as were reverse worded items, or those that had no effect on Cronbach's alpha. The final exploratory factor analysis yielded a 19 item four factor scale, explaining a total variance of 57.96%. The pattern matrix of the scale is presented in Table 42.

*Table 42 Four factor solution – Promax rotation extraction and Principal Axis Factoring. (*Commonalities)*

Item number and name		Factor 1	Factor 2	Factor 3	Factor 4	*Com
57	I am concerned my baby's weight makes me look like a bad mother	**0.884**	-0.014	0.056	-0.009	0.784
56	I am concerned what people will say about me because of my baby's weight	**0.860**	0.032	-0.019	0.018	0.752
58	I worry that other mothers talk about my baby's weight	**0.817**	-0.022	-0.064	-0.058	0.638
60	I am concerned that people will think I am a bad mother because of my baby's weight	**0.800**	-0.002	0.010	0.047	0.666
62	I worry the health visitor thinks that I am a bad mother because of my baby's weight	**0.769**	-0.035	0.004	0.006	0.591
55	I feel tense when it is obvious that people are looking at my baby	**0.733**	0.026	0.008	0.001	0.543
70	My baby being overweight now will increase the chance they will be overweight as a toddler	-0.005	**0.872**	-0.047	-0.035	0.756
76	My baby's future chance of being overweight is higher if they are overweight now	-0.027	**0.846**	0.017	-0.029	0.720
72	It is more likely that my child will be overweight when they are at school if they were overweight as a baby	-0.007	**0.820**	0.018	-0.036	0.679
68	My baby being overweight means they may have health problems in the future	0.031	**0.788**	-0.024	0.056	0.621
66	My baby being overweight as a toddler is bad for their health in the future	-0.007	**0.635**	0.045	0.066	0.413
30	I would feel like a bad mum if I gave my baby less breast/formula milk	0.074	0.029	**0.751**	0.005	0.586
31	I would feel guilty about giving my baby less breast/formula milk	0.043	0.017	**0.750**	-0.026	0.570
8	I find it difficult to resist my babies demands for breast/formula milk	-0.066	0.018	**0.667**	0.002	0.445
14	I sometimes feed my baby to help them sleep	-0.098	-0.037	**0.596**	-0.002	0.352
10	When my baby cries, I find it difficult to calm them down without giving them breast/formula milk	0.040	-0.017	**0.571**	0.015	0.330
39	I am unsure I would be able to tell if my baby was overweight	-0.056	-0.040	0.036	**0.785**	0.603
40	I am unsure I would be able to tell if my baby was obese	-0.023	0.010	0.026	**0.743**	0.546
41	I need the health visitor to help me recognise if my baby was becoming overweight	0.105	0.061	-0.082	**0.610**	0.418
Eigen Values		**4.319**	**3.218**	**2.166**	**1.310**	
Total % variance (57.965%)		**22.732**	**16.936**	**11.402**	**6.895**	
Cronbachs alpha		**0.92**	**0.89**	**0.79**	**0.75**	

6.4.4 Reliability

Alpha reliability coefficients (Cronbach, 1951) for the composite scale (0.79) and four factors, (Factor 1 (0.92), Factor 2 (0.89), Factor 3 (0.79) and Factor 4 (0.75)) all exceeded the recommended level of above 0.7 for a new scale (Nunally and Bernstein, 1994; Bland and Altman, 1997).

6.5 Interpretation

Following the identification of a four-factor solution, the factors were operationalised and descriptively labelled to reflect their theoretical and conceptual intent.

As summarised in Table 43 below, items broadly loaded onto their expected and respective factors. There were two exceptions to this; firstly, subscale three, which resulted from an amalgamation of items from constructs one and two, and secondly, maternal perception of causal attributions for infant weight (construct six). The four resulting subscales are discussed below.

Table 43 Items surviving Exploratory Factor Analysis

Subscale 1:	
Construct 4: Maternal fear of judgement	I feel tense when it is obvious that people are looking at my baby (Item 55)
	I am concerned what people will say about me because of my baby's weight (Item 56)
	I am concerned my baby's weight makes me look like a bad mother (Item 57)
	I worry that other mothers talk about my baby's weight (Item 58)
	I am concerned that people will think I am a bad mother because of my baby's weight (Item 60)
	I worry the health visitor thinks that I am a bad mother because of my baby's weight (Item 62)
Subscale 2 :	
Construct 5: Maternal perception of health and other related risks of obesity	My baby being overweight as a toddler is bad for their health in the future (Item 66)
	My baby being overweight means they may have health problems in the future (Item 68)
	My baby being overweight now will increase the chance they will be overweight as a toddler (Item 70)

	It is more likely that my child will be overweight when they are at school if they were overweight as a baby (Item 72)
	My baby's future chance of being overweight is higher if they are overweight now (Item 76)
Subscale 3:	
Construct 1: Maternal self-efficacy for preventing overfeeding/influencing weight through feeding and Construct 2: Maternal guilt/self-blame about infant overweight and guilt associated with reducing milk/food	I find it difficult to resist my babies demands for breast/formula milk (Item 8) (Construct 1)
	When my baby cries, I find it difficult to calm them down without giving them breast/formula milk (Item 10) (Construct 1)
	I sometimes feed my baby to help them sleep (Item 14) (Construct 1)
	I would feel like a bad mum if I gave my baby less breast/formula milk (Item 30) (Construct 2)
	I would feel guilty about giving my baby less breast/formula milk (Item 31) (Construct 2)
Subscale 4:	
Construct 3 Maternal self-efficacy for identifying infant overweight	I am unsure I would be able to tell if my baby was overweight (Item 39)
	I am unsure I would be able to tell if my baby was obese (Item 40)
	I need the health visitor to help me recognise if my baby was becoming overweight (Item 41)

Subscale one

A total of six items loaded onto subscale one, all of which were designed to measure maternal fear of judgement (Construct four). Factor loadings were high and ranged between .733 and .860. The surviving items were still thought to represent mothers' fear of judgement in relation to their infants' weight as originally intended. Therefore, this subscale was labelled maternal fear of judgement about infant overweight.

Subscale two

Five out of the original fourteen items designed to measure maternal perceptions of health and other related risks of obesity (Construct five) were loaded to become subscale two. Factor loadings were good for four of the items while Item 66 loaded slightly lower at 0.635. On review of the items, they appeared to capture a maternal awareness of the health consequences of infant overweight. Items designed to capture the more immediate health risks or implications of infant overweight, such as the impact of weight on walking and learning identified in the qualitative data, survived analysis. The subscale was therefore named 'Maternal awareness of the future consequences and tracking of infant overweight' to reflect this.

Subscale three

Subscale three amalgamated five items from two different constructs. Three from Construct one (8, 10 and 14), and two from Construct two (30 and 31). The three items from Construct one were originally designed to measure maternal self-efficacy to prevent overfeeding/influence weight through feeding. However, they more accurately represented practical challenges faced by mothers that lead to them to feed, such as a demanding or crying baby or one that will not sleep. The two other items (30 and 31) were created to capture maternal guilt and/or self-blame about infant overweight and guilt associated with reducing milk/food. The two surviving items reflected anticipated emotions of guilt associated with reduction of breast or formula milk. The other items designed to measure guilt or self-blame in relation to infant weight did not survive analysis, despite these being a strong theme in the qualitative data analysis. The five items that loaded onto subscale three appeared to be more a measure of the maternal drive to feed their infant as a way to soothe or console them and appease any feelings of guilt. In view of this, subscale three was named 'Maternal drive to feed'.

The fact that items from Constructs one and two did not load onto their expected and respective individual factors to create two separate subscales, could be due to a lack of clarity or poor definition of the original constructs. This is considered an important issue when designing constructs (Cabrera-Nguyen, 2010). For example, in Construct two, maternal guilt/self-blame about infant overweight and guilt associated with reducing milk/food attempted to measure two separate latent variables (self-blame and guilt). These may have been more successful if designed as two separate constructs. Guilt also related to two different areas (guilt about infant weight and guilt about feeding) which may have made interpretation of these items confusing. The loading of items 30

and 31 with 8, 10 and 14 is perhaps not unsurprising, as all relate to feeding. Other explanations could include the phrasing of the items.

Subscale four

Three of the original items from Construct three loaded onto the same factor (Factor 4) The original items purported to capture maternal perception of self-efficacy to identify the overweight. The three final items (39, 40 and 41) did this and highlighted the need for support by a professional to do so.

In summary, the exploratory factor analysis resulted in four subscales;

- Subscale one - Maternal fear of judgement about infant weight
- Subscale two - Maternal awareness of the future consequences and tracking of infant overweight
- Subscale three - Maternal drive to feed
- Subscale four - Maternal self-efficacy to identify infant overweight and obesity

As discussed above, the exploratory factor analysis resulted in four subscales, each measuring factors that may influence or act as barriers to parental engagement in the early prevention of obesity. Each of the subscales are scored on a 7-point Likert scale. The following paragraph describes how the results and scores of the subscale were interpreted.

For subscales one (fear of judgement about infant weight), three (drive to feed) and four (efficacy to identify infant overweight), participant agreement with the statements would result in a high score. These subscales are proposed as having a negative influence or acting as a barrier to engagement, either in initial conversations about an infant's future risk of overweight or on receptiveness to modify infant feeding practices. For example, a high score for maternal fear of judgement may negatively influence willingness to engage in conversations about their infants' weight with both peers and health professional, due to fear of being judged. By contrast, a high score for drive to feed would indicate perceived challenges to resisting infant demands, likely to act as a barrier to interventions to modify infant feeding practices. A high score on subscale four indicates low self-efficacy to recognise infant overweight which again may present barriers for raising the issue or concerns with a health professional or taking independent action. Conversely, for subscale two (awareness of consequences and

tracking of infant overweight), agreement with items suggests an awareness of the consequences and tracking. As discussed in Chapter three, the HBM purports that the perception of risk is a prerequisite of behaviour change and therefore, this awareness is likely to act as a facilitator or enabler of engagement. In order to be able to utilise subscale two with the others within a composite scale and interpret the results as a meaningful total score, items should be reverse scored so as for the other subscales, a high score would indicate a barrier to engagement. In summary, for the four subscales and total scale, a high score indicates that there are more existing barriers to engaging parents in the early prevention of childhood obesity.

6.6 Descriptive statistics

The descriptive statistics for the surviving nineteen items, four subscales and total scale for the sample (N=282) are shown in Table 44. None of the items were found to have out of range values. Mean item scores were between the lowest of 1.92 (SD 1.33) for Item 58, factor one and 4.89 (SD 2.01) and highest then for Item 14, factor three. The data was non normally distributed: skewness was between -0.70 (Item 14) and 1.73 (item 58) and Kurtosis was -1.18 (item 8) and 2.4 (item 58).

Table 44 Descriptive statistics of items surviving EFA

	Mean	SD	Range	Skewness	Kurtosis
Subscale One					
I am concerned my baby's weight makes me look like a bad mother (Item 57)	2.03	1.49	6 (1-7)	1.57	1.49
I am concerned what people will say about me because of my baby's weight (Item 56)	2.06	1.51	6 (1-7)	1.56	1.42
I worry that other mothers talk about my baby's weight (Item 58)	1.92	1.33	6 (1-7)	1.73	2.40
I am concerned that people will think I am a bad mother because of my baby's weight (Item 60)	2.11	1.49	6 (1-7)	1.39	1.04

I worry the health visitor thinks that I am a bad mother because of my baby's weight (Item 62)	2.09	1.45	6 (1-7)	1.47	1.34
I feel tense when it is obvious that people are looking at my baby (Item 55)	2.01	1.43	6 (1-7)	1.61	1.75
Subscale Two					
My baby being overweight now will increase the chance they will be overweight as a toddler (Item 70)	3.33	1.60	6 (1-7)	0.38	-0.76
My baby's future chance of being overweight is higher if they are overweight now (Item 76)	3.43	1.63	6 (1-7)	.55	-.57
It is more likely that my child will be overweight when they are at school if they were overweight as a baby (Item 72)	3.70	1.67	6 (1-7)	0.18	-0.95
My baby being overweight means they may have health problems in the future (Item 68)	2.90	1.67	6 (1-7)	.90	.01
My baby being overweight as a toddler is bad for their health in the future (Item 66)	2.61	1.27	6 (1-7)	.10	.83
Subscale Three					
I would feel like a bad mum if I gave my baby less breast/formula milk (Item 30)	4.49	1.85	6 (1-7)	-0.55	-.71
I would feel guilty about giving my baby less breast/formula milk (Item 31)	4.79	1.75	6 (1-7)	-0.24	-1.05

I find it difficult to resist my babies demands for breast/formula milk (Item 8*)	4.50	1.97	6 (1-7)	-.29	-1.18
I sometimes feed my baby to help them sleep (Item 14*)	4.89	2.01	6 (1-7)	-.70	-.95
When my baby cries I find it difficult to calm them down without giving them breast/formula milk (Item 10*)	3.04	1.61	6 (1-7)	.55	-.75
Subscale Four					
I am unsure I would be able to tell if my baby was overweight (Item 39)	3.05	1.53	6 (1-7)	0.73	-0.41
I am unsure I would be able to tell if my baby was obese (Item 40)	2.83	1.62	6 (1-7)	0.91	.05
I need the health visitor to help me recognise if my baby was becoming overweight (Item 41)	2.92	1.51	6 (1-7)	0.63	-0.47

Summary of EFA results

The Exploratory Factor Analysis reduced the original pool of items from 95 to 19 items. Two of the original constructs proposed within study one were not confirmed by the factors analysis so were deleted from the scale, along with redundant items. The factor analysis resulted in a 19-item four-factor solution.

6.7 Confirmatory Factor Analysis Study procedures

To confirm the factor structure of the exploratory factor analysis, a confirmatory factor analysis was performed on a second data set. Maternal fear of judgement about infant weight, maternal awareness of consequences of infant overweight, maternal drive to feed and maternal self-efficacy to identify infant overweight, were the latent variables for testing the proposed four factor model.

6.7.1 Sample

A new convenience sample of 645 parents with a child aged 12 months of age or younger were recruited between 29th October 2017 and 16th January 2018. The same inclusion and exclusion criteria were used as in part one.

6.7.2 Sampling and Sample Size

The new sample of participants were recruited from The Baby Centre website (www.babycentre.co.uk) using the same procedures as described for sample one. The sample were recruited from eight existing online community groups (Table 45).

Table 45 Community groups

Group Name (no of members)	Age of children in group (start of data collection)
Birth group - Jan 2017 (4343)	9-10 months
Birth group - April 2017 (4807)	6-7 months
Birth group - May 2017 (4989)	5-6 months
Birth group - June 2017 (4860)	4 -5 months
Birth group - July 2017 (5295)	3-4 months
Birth group - August 17 (5168)	2-3 months
Birth group - Sept 17 (4789)	1-2 months
Breastfeeding group (36, 696)	All ages

6.7.3 Sample size adequacy and missing data handling

The method for dealing with missing data is described in study procedures (section 6.3.4).

6.7.4 Data collection procedures and instruments

Data collection procedures were the same as described in section 6.3.5, with small changes made to the data collection instruments to reduce survey attrition.

Amendments included the removal of some unnecessary demographic questions, including parental perception of current infant weight status and paternal weight and height. Data was collected for all the original 95 items and the 19 items, surviving the exploratory factor analysis (Table 43), were set up as one block of randomised items at the start of the online survey. This was done to prevent missing responses for the key items due to survey fatigue and potential for subject bias.

6.7.5 Ethical considerations

The study was conducted in accordance with the ethical principles that have their origin in the Declaration of Helsinki, 1996, the principles of Good Clinical Practice and the Department of Health Research Governance Framework for Health and Social care, 2005. A revised ethics application was submitted to Anglia Ruskin, Faculty of Health Social Care and Education, Research Ethics Panel (DREP) SNM/DREP/15-007 on the 19.9.17. Although no new item was added or amendments made to the original data collection instruments, the original ethics application submitted required an extension of time to allow recruitment of a new sample. The application was approved on 22.9.17 (Appendix J).

6.8 Data Analysis procedures

A confirmatory factor analysis was performed using the maximum likelihood (ML) estimation method to confirm the factor structure of the four- factor 19 item PEOPS, using Amos 7 statistical package (Arbuckle, 2005).

6.8.1 Model Evaluation

Model evaluation was assessed by examination of goodness of fit indices, localised areas of strain and convergent and discriminant validity (Brown, 2015). Goodness of fit indices are one key aspect of model evaluation and although recognised as a good measure of global fit, are insufficient for identification of more specific areas of the analysis (Brown, 2015). Brown (2015) suggests that it is equally important to examine the solution in terms of localised strain, i.e., whether there are specific areas of the model that do not adequately reproduce the predicted model. This was assessed through examination of standardised residuals and modification indices, interpretability and strength of parameter estimates, statistical significance and direction and size of parameter estimates. Another method of model evaluation is the absence of ‘Heywood Cases’ (Heywood, 1931). These are negative error variances and standardised regression weights above one, which indicate the presence of an unacceptable solution.

6.8.2 Fit Indices

The use of different fit indices, the context of their use and cut off values, continues to be debated (Hu and Bentler, 1999). There are numerous indices; those most commonly used (Thompson, 2004 are the χ^2 statistical significance test, the normed fit index (NFI), otherwise known as the Tucker Lewis Index (TLI) (Bentler and Bonett, 1980), the comparative fit index (CFI) (Bentler, 1990) and the root mean square error of approximation (RMSEA) (Steiger and Lind, 1980). Brown (2015) categorises fit indices into three areas: absolute fit, fit adjusting for model parsimony and comparative or incremental fit (Table 46). Brown (2015) recommends that an index from each category is considered and reported, specifying the RMSEA, standardised root mean square residual (SRMR), CFI and TLI, due to their performance with Hu and Bentler stimulations (Hu and Bentler, 1999). Accordingly, these are the ones that are reported within this study. Either the SRMR or root mean square residual (RMR) are measures of absolute fit; in this case, RMR is reported, as this is the index output of the AMOS software. Criteria for adequate model fit is RMR < 0.10, the closer the RMR and SRMR are to zero the better the model fit (Marsh and Hocevar, 1985). The indices cut-offs are not provided here, as these can be affected by other factors such as the estimation method, sample size and normality of data (Hu and Bentler, 1999) so are discussed within the results section.

Table 46 Model Fit Indices

Absolute fit	Fit adjusting for model parsimony	Comparative or incremental fit
X^2	RMSEA	CFI
SRMR		TLI
RMR		

6.8.3 Localised areas of strain

Goodness of fit indices are useful to assess an overall ability of the model to reproduce the observed relationship between the indicators; however, they overlook specific areas within the model. For example, the fit indices may suggest an adequate model even if some relationships in the data have not been adequately reproduced. Conversely, some exceed the associations, known as localised areas of strain. The areas of strain are most commonly identified by standardised residuals and modification indices statistics. Standardised residuals indicate the number of standard deviations by which the fitted residual differs from the zero value residuals. A standardised residual as close

to zero as possible is considered the ideal but in reality, this is very rare so standardised residuals equal to or greater than 1.96 (rounded up to 2) are utilised (which corresponds to a statistically significant z-score). Standardised residuals are influenced by sample size, and larger sample sizes inflate the residuals, so cut offs of 2.58 are viewed as reasonable (Bryne, 2014). Modification Indices (MI) estimate how much the overall model χ^2 will decrease if the fixed or constrained parameters are freely estimated rather than being calculated as fixed to zero, including the error covariance. Small modification indices suggest a good model fit, although those of 3.84 or over (typically rounded to 4) suggest that the model could be improved by freely estimating the constrained or fixed parameter.

6.8.4 Reliability

The evaluation of reliability is key in the development of a psychometric multi-item measure. Reliability refers to the consistency of the measurement. Cronbach's alpha is perhaps the most common estimate of internal consistency of items in a scale (Cronbach, 1951; Cronbach and Shavelson, 2004) and is the method used to assess reliability of the PEOP scale and subscales. A criterion of between 0.70 and 0.95 is used as a measure of good internal consistency (Nunnally and Bernstein, 1994). In addition to the Cronbach's alpha, the composite reliability (CR) of the factors was also assessed, of which a value of above 0.7 is taken as the acceptable threshold (Hair, et al. 2010).

6.8.5 Validity

CFA is as an essential tool for construct validation and is used to evidence convergent and discriminant validity of theoretical constructs (Brown, 2015; Byrne, 2013). In order to establish the convergent and discriminant validity of factors in the CFA, three measures are utilised: Average Variance Extracted (AVE), Maximum Shared Variance (MSV) and Average Shared Variance (ASV). Convergent validity assesses the extent to which variables or items overlap or are strongly intercorrelated and therefore become one factor. Within the CFA, convergent validity is indicated when the AVE is above >0.5 (Hair, et al. 2010). Conversely, discriminant validity demonstrates that the observed variables or items are uncorrelated and load as separate factors, indicating that the broader construct has become separated into one or two factors. The discriminant validity of the factors is assessed through MSV and AVE. If MSV is less than the AVE and the square root of AVE is greater than the inter-construct correlations, then the thresholds of discriminant validity are met (Hair, et al. 2010).

6.9 Results

6.9.1 Participants (Sample two)

A total of 637 individuals met the inclusion criteria and consented to participate in the study (99% of the original sample of 645). Responses to the demographic questions answered by the mothers about themselves and their infant are summarised below in Table 47.

Table 47 Mother and infant characteristics (Study Two – Sample Two)

Mothers Characteristics	
Age in years n=555	n (%)
Under 20	3 (0.5)
20-24	41 (7.4)
25-29	143 (25.8)
30-34	234 (42.2)
35-39	111 (20)
40-44	19 (3.4)
45-49	4 (0.7
First time mother n=515	
Yes	283 (55)
No	232 (45)
Ethnicity n=553	
White	
English/Welsh/Scottish/Northern Irish/British	480 (86.8)
Irish	6 (1.1)
Any other White background	23 (4.2)
Mixed/Multiple ethnic groups	
White and Black Caribbean	2 (0.4)
White and Black African	2 (0.4)
White and Asian	2 (0.4)
Any other Mixed/Multiple ethnic	4 (0.7)
Asian/Asian British	
Indian	12 (2.2)
Pakistani	4 (0.7)
Bangladeshi	1 (0.2)
Chinese	2 (0.4)
Any other Asian background	3 (0.5)

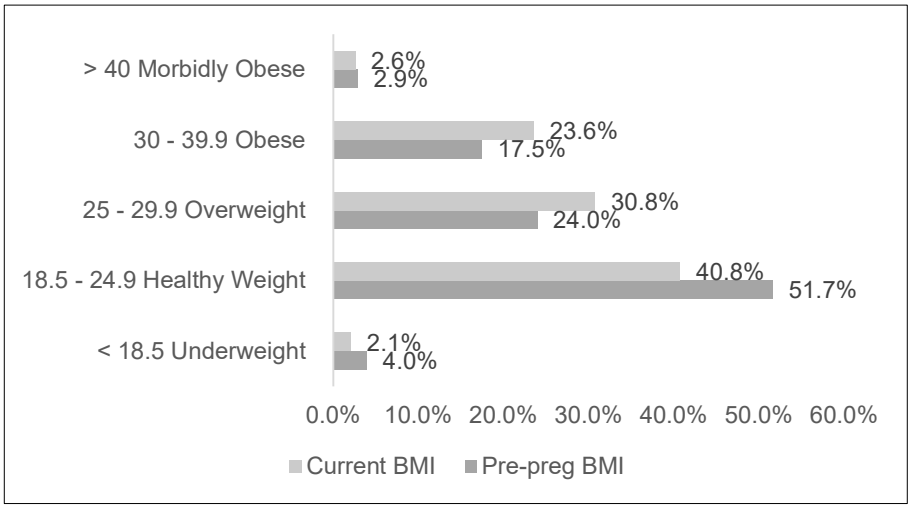
Black/ African/Caribbean/Black British	
African	6 (1.1)
Caribbean	2 (0.4)
Other ethnic groups	
Arab	4 (0.7)
Education: n=553	
No formal qualifications	0
GCSEs or equivalent	44 (8)
A Levels or equivalent	135 (24.5)
Undergraduate Degree or equivalent	217 (39.2)
Postgraduate Degree or equivalent	157 (28.4)
Employment status, n=553	
Employed	480 (86.8)
Unemployed	53 (9.6)
Self-employed	20 (3.6)
Smoking status during pregnancy, n=556	
No smoking	533 (95.8)
Yes smoked	11 (2)
Occasionally	12 (2.2)
Maternal Height n=548	
Range	147cm (4ft10) – 188cm (6ft2)
Mean	165cm (5ft5)
Pre-pregnancy weight, n=531	
Range	38.1kg (6st) – 130.1kg (20st7lb)
Mean	70.18kg (11st 1lb)
Pre-pregnancy BMI n=526	
Range	15.36kg/m^2 - 50.82kg/m^2
< 18.5 Underweight	21 (4)
18.5 - 24.9 Healthy Weight	272 (51.7)
25 - 29.9 Overweight	126 (24)
30 - 39.9 Obese	92 (17.5)
> 40 Morbidly Obese	15 (2.9)
Maternal Weight n=533	
Range	40.82kg (6st 6lb) – 127.4kg (20st 1lb)
Mean	73.31kg (11st 8lb)
Maternal BMI n=529	

Range	15.84kg/m^2 -47.89kg/m^2
< 18.5 Underweight	11 (2.1)
18.5 - 24.9 Healthy Weight	216 (40.8)
25 - 29.9 Overweight	163 (30.8)
30 - 39.9 Obese	125 (23.6)
> 40 Morbidly Obese	14 (2.6)
Infant Characteristics	
Gender, n=533	n (%)
Male	279 (52.3)
Female	254 (47.7)
Age (n=490)	
12 weeks and under	128 (26.1)
13 – 26 weeks	209 (42.7)
27 - 39 weeks	96 (19.6)
40 – 52 weeks	57 (11.6)
Was your infant premature n=533	
Yes	45 (8.4)
No	488 (91.6)
Birthweight – Ranges, n=531	
< 2kg	7 (1.3)
2-2.95kg	90 (16.9)
3-3.95kg	332 (62.5)
4-4.95kg	87 (16.4)
Current Method of Feeding, n=515	
Formula	192 (37.3)
Breast	255 (49.5)
Mixed	68 (13.2)
Infants ever breastfeed, n=515	
Yes	445 (86.4)
No	70 (13.6)
Months of exclusive breastfeeding, n=490	
Not at all	84 (17.1)
1 week or less	63 (12.9)
4 weeks of less	53 (10.8)
8 weeks or less	42 (8.6)
12 weeks or less	36 (7.3)

16 weeks of less	24 (4.9)
20 weeks or less	34 (6.9)
24 weeks or less	26 (5.3)
Until there were over 6 months	69 (14.1)
Between 6 -12 months	59 (12)
Age solid foods introduced, n=494	
No solid food yet	253 (51.2)
Around 3 months old	2 (0.4)
Around 4 months old	24 (4.9)
Around 5 months old	61 (12.3)
Around 6 months old	141 (28.5)
Older than 6 months	13 (2.6)

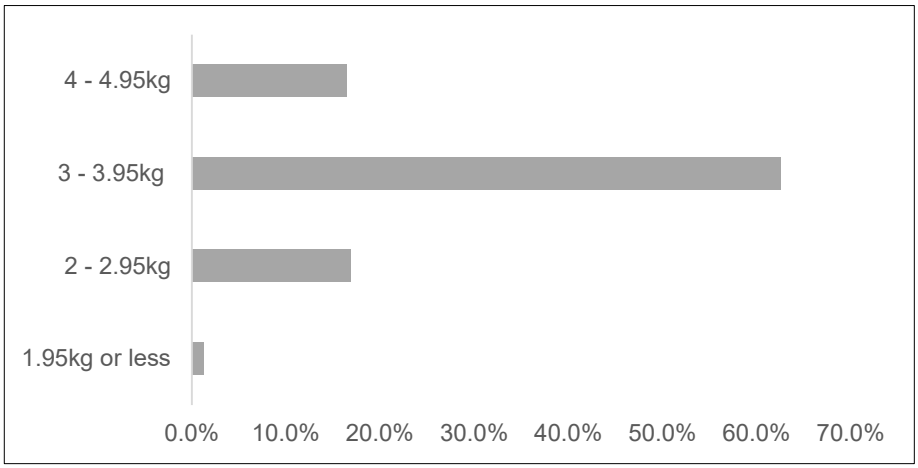
All participants were female, the majority were between 30-34 years of age (42.2%, n=234) and were first time mothers (55%, n=283). Most were of English/Welsh/Scottish/Northern Irish ethnicity (86.8%, n=480), educated to degree level or above (67.6%, n=374) and employed prior to pregnancy (86.8%, n=480). Data on occupation was also collected and is available on request. Most mothers reported that they never smoked during pregnancy (95.8%, n=533). Current and pre-pregnancy body mass index (BMI) indicated that 44.4% of mothers were overweight or obese prior to pregnancy, increasing to 57% after pregnancy (Figure 8). Paternal height and weight were also collected but not presented and is available upon request.

Figure 8 Maternal Body Mass Index (BMI)



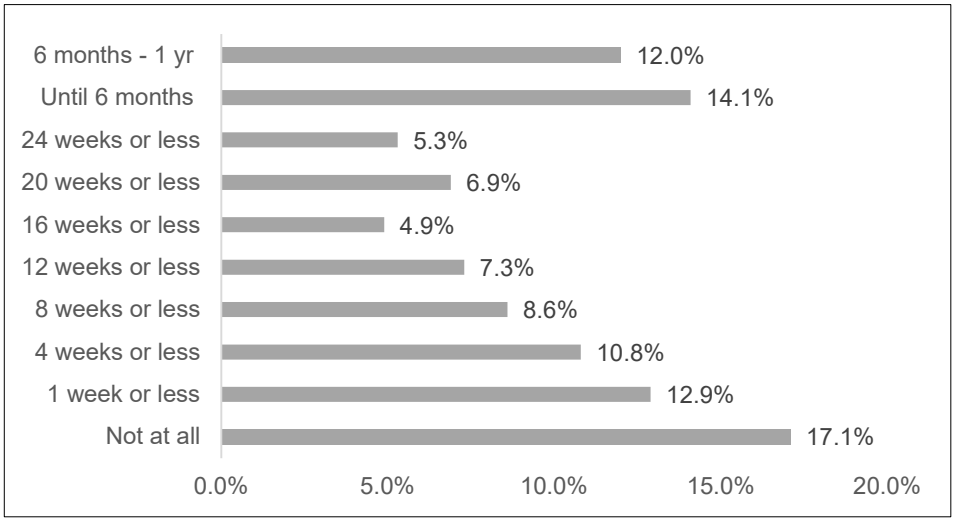
A slightly larger proportion of the infant sample were male (52.3%, n=279). The majority of infants had a birth weight ranging between 3- 3.95kg (62.5%, n=332) (Figure 9).

Figure 9 Infant birth weight



Data collected on feeding (see Figure 10) identified that a high number of infants had been breastfed for some period of time (86.4%, n=445) but only 14% had been breast fed exclusively for six months (n=69). At the time of data collection more mothers described their current method of infant feeding as breastfeeding (49.5%, n=186) compared to those formula feeding (37.3%, n=192). For those who had begun on solid foods, the majority of infants were weaned at around six months (28.5%, n=141).

Figure 10 Months exclusively breastfed



Following collection of demographic data, mothers were also asked about their preferences towards receiving information about their infants' future risk of becoming overweight. Over fifty percent of mothers indicated that they would want to be given information about future risk (Figure 11). Preference on when they would want to be

given this information varied (Figure 12) but an overwhelming majority stated that they would like to receive the information via a face to face conversation (84%, n=216).

Figure 11 Mothers response to receiving information about their infant's chance of future risk

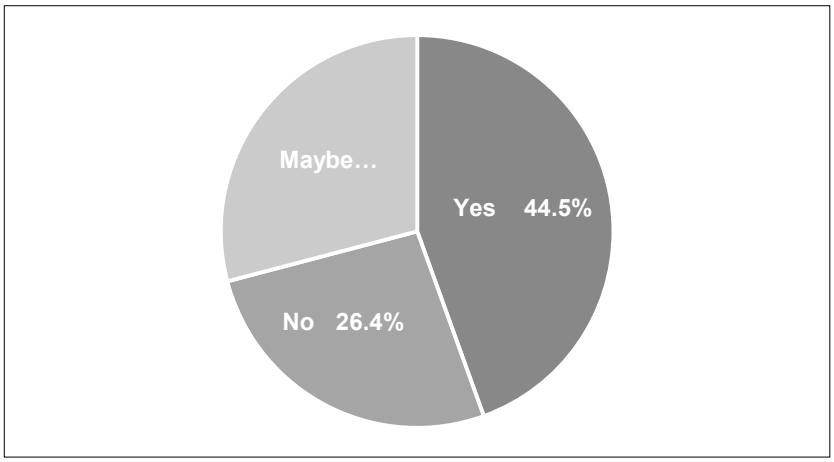
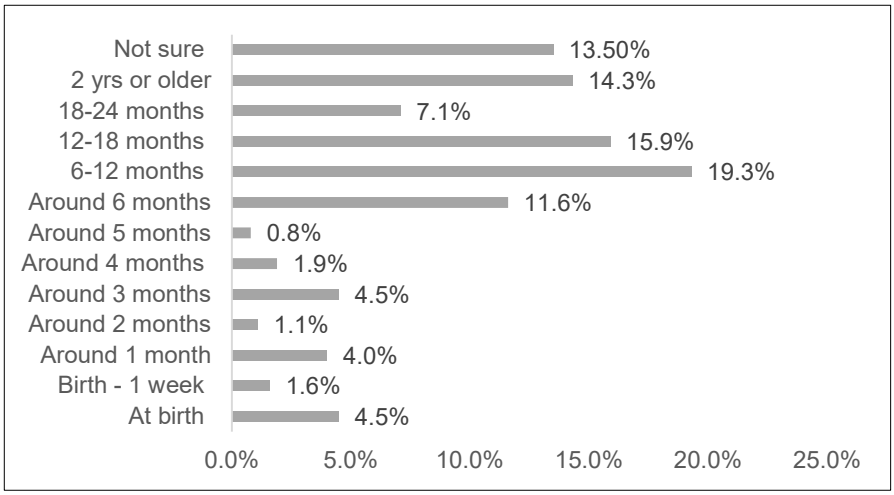


Figure 12 Preferred time of risk assessment



Ninety-seven participants (15.2%) responded to a voluntary option to add any free text at the end of the survey. The comments were reviewed by the interviewer and a member of the supervisor team (SR) and were grouped based on the main areas of feedback below. A full version of the comments is available on request.

- Poor management of underweight, flawed and inconsistent advice. Pressure from health visitors to formula feed up to the desired centile.
- Belief that breastfed babies cannot be overfed; concern that we are suggesting they reduced demand feeding, because breastfeeding is also for baby comfort and that shouldn't be denied.

- View from some that genetics or family history have a strong role in infant size and growth.
- Criticism of health visitors providing inconsistent advice – and some quotes suggesting that HVs aren't familiar with the evidence.
- Criticism of questionnaires, no distinction between formula and breastfed, omission of length, negatively worded questions.

6.9.3 CFA - Sample size and missing data

Following exclusion of missing data, a sample size of 446 (70% of the original sample n=637) was used for confirmatory factor analysis. Initially, 147 cases were deleted due to not continuing with the survey beyond the initial demographic questions, leaving 490 cases. Little's MCAR test identified item 70 as having 9% (44 cases) of data missing. This can be explained by its later appearance within the survey, causing it to be impacted by survey attrition rather than being due to a particular problem with this item; this was confirmed by a non-significant (p 0.141) Little's MCAR test. The 44 cases not completing all 19 items were deleted from the sample, leaving 446 cases for confirmatory factor analysis.

Descriptive statistics for the 19 items are presented in Table 48. None of the variables were found to have out of range values, the mean response scores varied between factors and ranged from 2.11 (item 62) to 5.15 (item 31) and standard deviations, between 1.39-1.95. The data was not normally distributed (West, 1995). Skewness ranged between -1.62 (SE = 0.12; Item 40) and 1.55 (SE = 0.12; Item 62). Kurtosis ranged between 2.40 (SE = 0.23 Item 40) and -1.18 (SE = 0.23; item 76). Normality of data is not an assumption of the factors analysis; however, it should be noted that severe non-normality can result in inflated X^2 values, underestimation of fit indices TLI and CFI and moderate to severe underestimation of the standard errors of parameter estimates (West, Finch and Curran, 1995).

Table 48 Descriptive statistics (Sample Two – CFA N=446)

	Mean	SD	Range	Skewness	Kurtosis
Subscale 1: Fear of judgement					
I am concerned my baby's weight makes me look like a bad m other (Item 57)	2.59	1.60	6 (1-7)	0.99	-0.05
I am concerned what people will say about me because of my baby's weight (Item 56)	2.61	1.63	6 (1-7)	1.02	0.05
I worry that other mothers talk about my baby's weight (Item 58)	2.39	1.53	6 (1-7)	1.18	0.38
I am concerned that people will think I am a bad mother because of my baby's weight (Item 60)	2.48	1.61	6 (1-7)	1.18	0.36
I worry the health visitor thinks that I am a bad mother because of my baby's weight (Item 62)	2.11	1.39	6 (1-7)	1.55	1.73
I feel tense when it is obvious that people are looking at my baby (Item 55)	2.79	1.69	6 (1-7)	0.76	-0.58
Subscale 2: Consequences of overweight					
My baby being overweight now will increase the chance they will be overweight as a toddler (Item 70)	3.83	1.61	6 (1-7)	-0.23	-0.94
My baby's future chance of being overweight is higher if they are overweight now (Item 76)	3.98	1.73	6 (1-7)	-0.09	-1.18
It is more likely that my child will be overweight when they are at school if they were overweight as a baby (Item 72)	4.30	1.64	6 (1-7)	-0.11	-1.04

My baby being overweight means they may have health problems in the future (Item 68)	3.12	1.68	6 (1-7)	-0.72	-0.46
My baby being overweight as a toddler is bad for their health in the future (Item 66)	2.83	1.39	6 (1-7)	-0.94	0.49
Subscale 3: Drive to feed					
I would feel like a bad mum if I gave my baby less breast/formula milk (Item 30)	4.99	1.63	6 (1-7)	-0.65	-0.61
I would feel guilty about giving my baby less breast/formula milk (Item 31)	5.15	1.56	6 (1-7)	-0.82	-0.22
I find it difficult to resist my babies demands for breast/formula milk (Item 8*)	4.90	1.94	6 (1-7)	-0.66	-0.71
I sometimes feed my baby to help them sleep (Item 14*)	5.03	1.95	6 (1-7)	-0.72	-0.82
When my baby cries I find it difficult to calm them down without giving them breast/formula milk (Item 10*)	3.62	1.75	6 (1-7)	-0.21	-1.08
Subscale 4: Recognition of infant overweight					
I am unsure I would be able to tell if my baby was overweight (Item 39)	2.80	1.43	6 (1-7)	0.93	0.10
I am unsure I would be able to tell if my baby was obese (Item 40)	2.26	1.37	6 (1-7)	1.62	2.40
I need the health visitor to help me recognise if my baby was becoming overweight (Item 41)	2.79	1.52	6 (1-7)	0.80	-0.35

6.9.4 Model Evaluation

All the observed indicator variables loaded significantly (p<0.001) onto the proposed latent factors. The indicator variables were congeneric (Joreskog, 1971), that is to say that they shared a common factor and did not load onto more than one factor. The standardised factor correlations/regression weights ranged between 0.96 (Item 31, factor 3) and 0.30 (Item 8, factor 4). None exceeded 1.0 or had negative factor variances indicating that there were no Heywood Cases. The majority exceeded the desired cut-off of .70, although three of the indicators on the latent factor three (drive to feed) had lower factor correlations (0.42 and below). As predicted, there was some bidirectional correlation/covariance between the latent factors. However, this was small and was only positively and significantly exhibited between the latent variables of fear of judgement and consequences (0.156 p0.001) and need to feed and efficacy to recognise (0.11 p0.01).

Within this model, measurement error was presumed to be unsystematic or random, so correlated measurement errors did not exist between any of the pairs of observed indicator variables. This implies that the observed covariance between indicators loading on the same factor can be explained entirely by the unobserved variable/construct.

6.7.5 Goodness of Fit

Goodness of fit indices are reported in Table 49. The root mean square residual (RMR) of 0.18 indicated a reasonable model fit (Marsh and Hocevar, 1985). For completeness, X^2 is also reported, the X^2 value being 464.9 (p<.000). Others have recognised this limitation and have suggested that a ratio of X^2 and degrees of freedom with a ratio of $\leq$ 2 is a better assessment of good fit (Cole, 1987. However, for the proposed four factor model, the resulting value of 3.18 would also suggest a poor model fit. Nevertheless, a significant value implies a poor model fit and it is well recognised that this is sensitive to large sample sizes, so other indices should be prioritised when evaluating the model fit (Brown, 2015). The root mean square error of approximation (RMSEA), a well utilised index from the model parsimony category, was 0.07, a value below 0.08 cited as an adequate model fit by Browne and Cudeck (1992). Comparative fit index (CFI) was 0.933 and the Tucker Lewis index (TLI) was 0.921, so between 0.90-0.95 which is indicative of an acceptable model fit, (Bentler, 1990). In addition, the CFI is close to 0.95, which is seen as a good model fit by Hu and Bentler (1999).

Table 49 Goodness of fit for four-factor model

	X^2	df	$X^{2\ /\ df}$	RMSEA	RMR	CFI	TLI
Proposed four-factor model (19 item)	464.9 (p< .000)	146	3.18	0.07	.187	0.933	0.921

6.6.6 Localised areas of strain

In order to identify specific areas of poor fit, standardised residuals and modification indices were examined. In this case, the goodness of fit indices indicated an acceptable model fit although inspection of the standardised residuals and modification indices suggested there were some areas of localised strain within the model. Given the sample size, 2.58 was used as the cut off (Bryne, 2014). As expected, most of the standardised residuals were below this acceptable threshold, although a few exceeded this, as highlighted in Table 50. The highest SR was 9.564 (between item 14 and 10), followed by a SR of 5.045, between item 10 and item 8, followed by an SR of 4.167 between items 14 and 8. The raised standardised residuals identified items 14, 10 and 8 as focal areas of misfit within the model. These high positive standardised residuals suggest that additional parameters may be required in the model in order to account for the covariance between the indicators. Inspection also identified a number of negative standardised residuals, the greatest being -2.828 between items 41 and 76. Conversely to those exceeding the threshold, a negative residual suggests that the model parameters may overestimate the relationship between two indicators to some extent (Brown, 2015).

Table 50 Localised areas of strain

	Item 14	Item 8	Item 39	Item 40	Item 41	Item 30	Item 31	Item 10	Item 70	Item 76	Item 72	Item 68	Item 66	Item 57	Item 56	Item 58	Item 60	Item 62	Item 55
Item 14	0																		
Item I8	**4.167**	0																	
Item 39	0.115	1.785	0																
Item 40	0.736	1.739	-0.018	0															
Item 41	0.987	2.367	0.085	-0.033	0														
Item 30	-0.751	-0.299	-0.264	0.028	-0.564	0													
Item 31	-0.163	-0.226	0.031	0.221	-0.737	0.038	0												
Item 10	**9.564**	**5.045**	0.069	1.601	1.274	-0.354	-0.247	0											
Item 70	-0.792	-0.099	1.345	1.616	-1.621	1.102	1.122	0.676	0										

	Item 14	Item 8	Item 39	Item 40	Item 41	Item 30	Item 31	Item 10	Item 70	Item 76	Item 72	Item 68	Item 66	Item 57	Item 56	Item 58	Item 60	Item 62	Item 55
Item 76	-2.511	-0.394	0.496	1.634	**-2.828**	0.072	-0.33	-2.685	0.254	0									
Item 72	-1.586	-0.348	-0.868	-0.13	-2.704	0.576	0.431	-1.387	-0.084	-0.024	0								
Item 68	-1.599	-1.507	0.212	1.25	-1.704	0.03	-0.269	-1.209	-0.332	-0.348	0.19	0							
Item 66	-2.396	-0.903	1.379	-0.198	-2.336	-1.135	-1.316	-1.3	-0.643	0.055	0.011	1.24	0						
Item 57	-0.252	-0.51	0.143	0.647	-2.399	-0.331	-0.395	-0.219	1.823	1.22	1.657	0.972	-0.085	0					
Item 56	-0.184	-1.276	0.242	0.451	-2.203	-0.876	-0.901	-0.925	0.215	0.136	0.799	0.343	-0.623	0.563	0				
Item 58	-0.231	-0.554	0.347	0.128	-1.946	0.137	0.639	-0.212	-0.93	-1.659	-0.264	-0.049	-1.147	-0.571	0.077	0			
Item 60	0.296	0.473	0.639	0.605	-1.737	0.617	0.469	0.541	-0.234	-0.749	0.118	0.792	-1.674	0.018	-0.411	0.3.28	0		
Item 62	-0.107	-0.389	1.375	0.44	-2.086	-0.239	-0.554	0.109	1.221	-0.893	-0.434	0.158	-1.681	0.218	-0.181	-0.351	0.088	0	
Item 55	-0.979	-1.721	-1.629	-1.967	-2.682	-2.395	-1.652	-1.738	-0.058	-0.547	0.376	1.481	-0.48	-0.35	1.617	0.405	-0.36	-0.335	0

Table 51 shows the modification indices. All indices were reasonably high although the error covariance between e-16 (item 10) and e-15 (item 14) well exceeded (127.780) the cut off value of 4. The MI of 34.871, between error covariance e-16 (item 10) and e-14 (item 8), was the second highest. Both the MI and SR indicate that items 8, 10 and 14 are the focal areas of the strain within the model.

Table 51 Modification Indices

			Modification Indices	Par Change
e15	<-->	Consequences	6.062	-.189
e14	<-->	Recognition	5.157	.213
e14	<-->	e15	21.620	.755
e18	<-->	Consequences	5.779	.094
e19	<-->	Consequences	12.316	-.178
e19	<-->	Judgement	5.999	-.129
e12	<-->	e15	5.637	-.164
e16	<-->	Consequences	5.859	-.161
e16	**<-->**	**e15**	**127.780**	1.581
e16	**<-->**	**e14**	**34.871**	.827
e8	<-->	e18	4.529	.099
e8	<-->	e19	6.146	-.150
e8	<-->	e16	6.245	-.198
e9	<-->	Recognition	4.562	-.113
e11	<-->	e10	5.451	.169
e1	<-->	Consequences	19.876	.138
e1	<-->	e7	4.825	.089
e1	<-->	e8	5.076	.083
e1	<-->	e10	4.296	-.098
e2	<-->	e1	13.038	.120
e3	<-->	Consequences	6.726	-.087
e3	<-->	e13	6.915	.075
e3	<-->	e8	5.460	-.094
e3	<-->	e1	18.645	-.120
e4	<-->	Soothe	5.314	.053

			Modification Indices	Par Change
e4	<-->	Consequences	4.496	-.057
e4	<-->	e10	5.321	.096
e4	<-->	e2	16.744	-.116
e4	<-->	e3	14.548	.090
e5	<-->	e17	6.294	.111
e5	<-->	e7	11.426	.174
e6	<-->	Recognition	5.959	-.177
e6	<-->	Soothe	4.431	-.106
e6	<-->	e12	4.599	-.115
e6	<-->	e2	16.287	.261
e6	<-->	e4	4.281	-.091

6.9.8 Model revision

Since the goodness of fit could not be verified by the modification indices (MI) or the standardised residuals (SR), a decision was made to revise the original CFA model. In the initial model, the measurement error was presumed as random. However, the MI and SR suggest that some covariation between the observed measures may be related to measurement error (not just the latent variable itself), so their covariation is not uniquely due to the common factor but to other exogenous factors, such as method effects. Model modification should begin by freely estimating the parameter with the largest MI but there should be a substantive basis for doing so and if not, the second largest should be considered and so on (Joreskog, 1993). In the first instance, a correlated error was predicted to exist between items 10 and 14 (e-16 and e-15) but this proved of little benefit, so a correlated error was also predicted between e-16 and e-14 (item 8). Justification for specifying correlated errors between items 8, 10 and 14 was supported by both theory and the influence of method effects. Method effects thought most likely to be influencing the covariation between these items and the latent variable (8, 10 and 14) is the reverse scoring of these items. However, this could have also been influenced by similar wording of the items and/or acquiescence of social desirability of the items (Brown, 2006. Following model revision, the modification indices improved, and standardised residuals all fell below the threshold of 2.58. The final model is shown in Figure 13 below.

Figure 13 Four factor model with standardised factor loadings and correlations (n446).

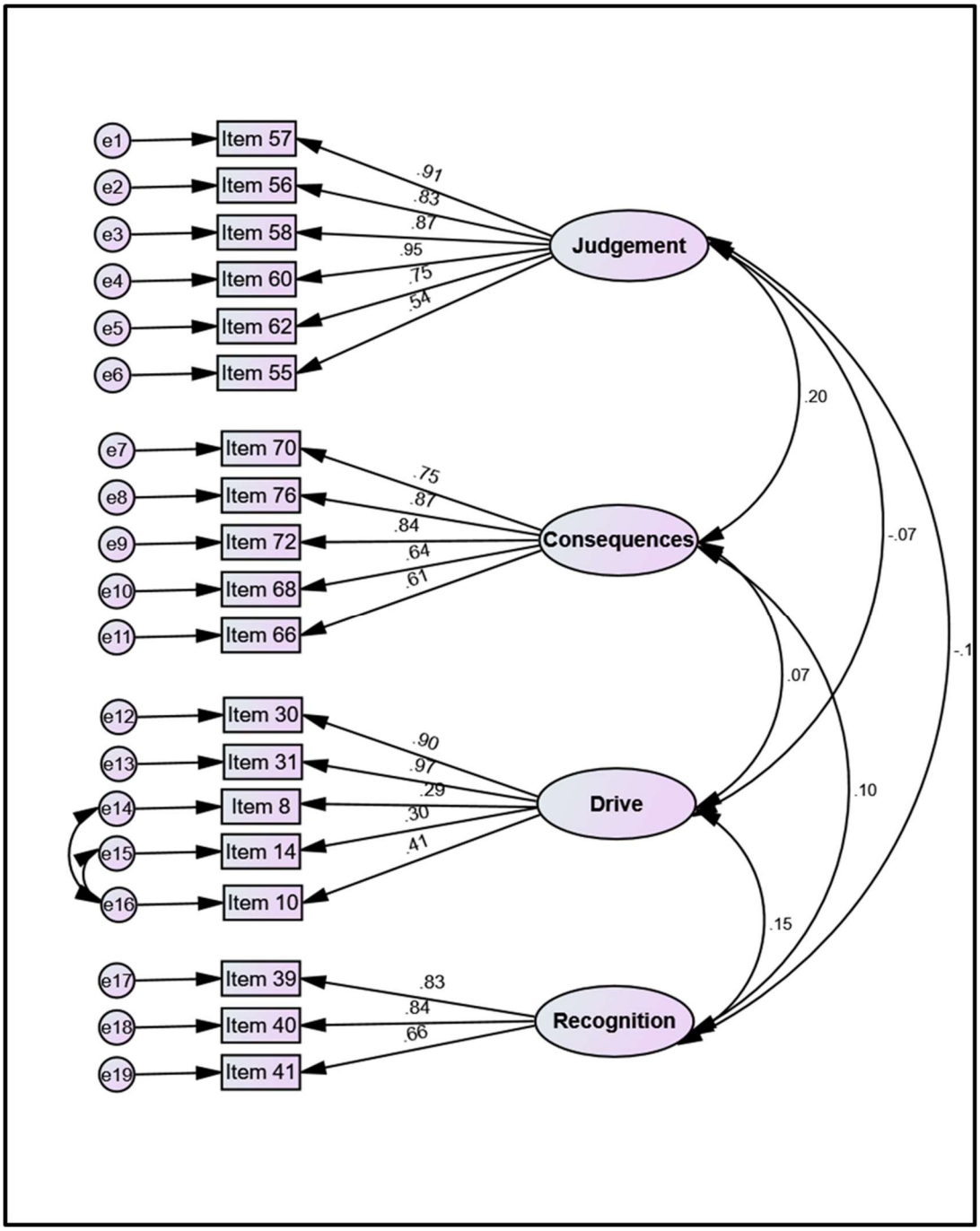


Figure 13 shows the final four factor model with standardised loadings and factor intercorrelations. With the exception of subscale 3, drive to feed, the standardised factor loadings were all above 0.5, with most being greater than .75. The highest loading variable was item 31 within Factor 3 (0.97). Three out of four factors exhibited similarly high mean loadings; factor 1 of .80 was the highest, followed by Factor 4, 0.78 and Factor 2, 0.74. The mean loading of factor three was considerably lower at 0.57. None of the factor loadings exceeded 1.0 or were negative, indicating there were no Heywood Cases.

Unstandardised regression weights demonstrated that all the indicator variables, even the lower loading items (8,10 and 14) loaded significantly onto their respective factors ($p<0.001$). The standardised correlations between the four factors were low (r=<.2). This indicates that there is little relationship between them, and each could therefore be seen as a conceptually unique measure of engagement.

Goodness of fit indices following model revisions are reported in Table 52. Indices suggest an improved model fit. For example, the RMR fell from of 0.18 to 0.15, as did the RMSEA. The X^2 remained significant however as did the ratio of X^2 and degrees of freedom reduced, bringing it much closer to the ideal of ≤ 2, which is an assessment of good fit (Cole, 1998). Both the CFI and TLI were improved by the model re-specification, increasing from below, to above 0.95, categorised as a good model fit by Hu and Bentler (1999).

Table 52 Goodness of fit – Revised model

	X^2	**df**	**$X^{2\,/\,df}$**	**RMSEA**	**RMR**	**CFI**	**TLI**
Original model	464.9 (p< .000)	146	3.18	0.07	0.19	0.933	0.921
Revised model 1 (Correlated error between e-16-and e-15)	315.718 (p<.000)	145	2.17	0.051	0.15	0.964	0.958
Revised model 2 (Correlated error between e-16 and e-15) and (e-16 and e-14)	298.016 (p<.000)	144	2.07	0.049	0.14	0.968	0.961

6.9.9 Reliability

The alpha reliability coefficient (Cronbach, 1951) of the scale was 0.74 and the four subscales, (Factor 1 (0.91), Factor 2 (0.85), Factor 3 (0.75) and Factor 4 (0.81)) all exceeded the acceptable level of 0.7. The highest level of reliability was demonstrated by Factor 1, followed by Factor 2. Scale reliability was also assessed by a composite reliability of > 0.7 (Hair, et al. 2010). The composite reliability (CR) of all four factors meet the acceptable threshold of >.7 (Table 53).

Table 53 Validity and reliability – CFA

	CR	AVE	MSV	Max R(H)	F1	F2	F3	F4
Factor 1: Judgement	0.924	0.675	0.040	0.956	**0.822**			
Factor 2: Consequences	0.861	0.559	0.040	0.889	0.201	**0.747**		
Factor 3: Drive	0.739	*0.419	0.023	0.951	-0.074	0.070	**0.647**	
Factor 4: Recognition	0.821	0.607	0.023	0.841	-0.099	0.097	0.150	**0.779**

Note: Figures in bold are the square root of AVE. CR: Composite Reliability, AVE: Average Variance Extracted, MSV: Maximum Shared Variance, MaxR(H): Maximum Reliability.

6.9.10 Validity

The CFA provided good evidence of construct validity through both convergent and discriminant validity of the factors. As shown in Table 53, all four factors demonstrated discriminant validity both via a maximum shared variance (MSV) less than the average variance extracted (AVE) (MSV<AVE), and a square root of AVE greater than the inter-construct correlations (Hair, et al. 2010). This indicates that, as hoped, none of the 19 remaining variables correlated more highly with variables from other factors, than their own. In other words, they remained distinct to the factor onto which they loaded. Three out of four of the factors (1, 2 and 4) had an AVE >0.5 (Table 53), thereby confirming convergent validity. This indicates a good correlation between the variables within each of the factors and that each of the individual factors are well explained by their observed variables.

In summary, the confirmatory factor analysis confirmed the four-factor model identified from the exploratory factor analysis. The final PEOP scale comprises of 9 items, assessing four aspects of parental engagement, through four distinct factors: maternal fear of judgement about infant weight; maternal awareness of consequences and tracking of infant overweight; maternal drive to feed and maternal efficacy to identify infant overweight (Table 54).

Table 54 The PEOP Scale

Subscale 1: Fear of judgement about infant weight
I am concerned my baby's weight makes me look like a bad mother (Item 57)
I am concerned what people will say about me because of my baby's weight (Item 56)
I worry that other mothers talk about my baby's weight (Item 58)
I am concerned that people will think I am a bad mother because of my baby's weight (Item 60)
I worry the health visitor thinks that I am a bad mother because of my baby's weight (Item 62)
I feel tense when it is obvious that people are looking at my baby (Item 55)
Subscale 2: Knowledge of future consequences and tracking of infant overweight
My baby being overweight now will increase the chance they will be overweight as a toddler (Item 70)
My baby's future chance of being overweight is higher if they are overweight now (Item 76)
It is more likely that my child will be overweight when they are at school if they were overweight as a baby (Item 72)
My baby being overweight means they may have health problems in the future (Item 68)
My baby being overweight as a toddler is bad for their health in the future (Item 66)
Subscale 3: Drive to feed
I would feel like a bad mum if I gave my baby less breast/formula milk (Item 30)
I would feel guilty about giving my baby less breast/formula milk (Item 31)
I find it difficult to resist my babies demands for breast/formula milk (Item 8*)
I sometimes feed my baby to help them sleep (Item 14*)
When my baby cries, I find it difficult to calm them down without giving them breast/formula milk (Item 10*)
Subscale 4: Self-efficacy to identify infant overweight
I am unsure I would be able to tell if my baby was overweight (Item 39)
I am unsure I would be able to tell if my baby was obese (Item 40)
I need the health visitor to help me recognise if my baby was becoming overweight (Item 41)

Scoring: 7-point Likert scale. Factors 1, 3 and 4 scored: 7 = Strongly Agree, 6 = Agree, 5 = Somewhat Agree, 4 =Neither Agree nor Disagree, 3 = Somewhat disagree, 2 = Disagree, 1= Strongly Disagree. Factor 2: Reversed: 1 = Strongly Agree, 2 = Agree, 3 = Somewhat Agree, 4 =Neither Agree nor Disagree, 5 = Somewhat disagree, 6 = Disagree, 7= Strongly Disagree.

6.10 Discussion

The results of the CFA provided good evidence of construct and discriminant validity. The discriminant validity provides further evidence of how the subscales are conceptually unique measures of engagement. With the exception of subscale three, there was good convergent validity. The lower convergent validity of subscale three (maternal drive to feed) suggests that items 30, 31, 8, 10 and 14 did not correlate well with each other within the subscale. As discussed above, subscale three, drive to feed, evolved from a combination of items from two different domains, which likely explains the limited convergence. This is evident from the factor loadings of the five items which are high for items 30 and 31 that evolved from domain two and conversely, low for items 8,10 and 14 evolving from domain one. The results highlight that these latent factors, items 8, 10 and 14 collectively accounted for only 34% of the overall variance of this subscale, compared to 94% for item 31 and 82% of item 30. This suggests that this factor may have been more stable as a two-item subscale. These results suggest that further exploratory analysis should have been performed to explore the role of these items in the measurement of maternal drive to feed (Brown 2015, pg.153). Future research should focus on additional qualitative and exploratory factor analysis to understand the role of these to dimensions in the construct. All subscales showed good divergent validity, meaning that they are all well explained by their own observed variables (items) and not better explained by items from another subscale.

The scale and subscales also demonstrated a good level of internal consistency reliability suggesting that the scale and subscales measures are likely to produce consistent results in different conditions. The Cronbach's alpha of subscale one was slightly higher (0.91) than the other three subscales. As outlined in section 6.6.4 acceptable values of alpha, range from 0.70 to 0.95 indicating all results met these criteria. The reliability results allow for confident use of the composite scale and independent use of the four subscales. The reliability of the scale is further supported by the comparable subscale scores of the two samples (Table 55). The CFA also demonstrated the scales construct validity however given that the convergent validity of Factor three fell just below the threshold this subscale should be interpreted with caution. The significance and implications of the scale in relation to existing research and the implications for clinical practice and future research is discussed within Chapter seven.

6.10.1 Strengths and limitations of scale

In situations where the original CFA model is revised, caution should be applied to model interpretation, particularly when substantial changes have been made (Brown, 2015). Although model revisions were made, in this case the revisions were minor and did not include the major revisions seen in other models. Major issues for revision would include an improper number of factors resulting from an absence of an exploratory factor analysis, in order to provide a conceptual and empirical basis for the CFA. This was not the case for this model, in which an EFA established the appropriate number of factors and pattern of item and factor relationships. The most common reason for revising a model is to improve the fit indices; this was not necessary as the indices of the original model showed a good fit and was empirically justified by the high standardised residuals and modification indices. Ideally, modified solutions should be replicated within an independent sample, or to split the original sample to revalidate the revised model in half of the sample, time constraints precluded. Because the model was not changed substantially, this was of less significance. A strength of the present study is in following recommended guidelines and that different data sets were used to generate and then confirm the factor structure. It was not possible to test the concurrent validity of the scale as there are no existing comparable scales. Test retest was also not performed so should be considered for future studies. A final limitation relates to subscale three of the PEOP scale. This was the least stable factor due to the low factor loadings of three out of five of the items. Further exploratory factor analysis should be performed, and the original two concepts re-examined to confirm the factor structure. This may involve a review of the original items designed to measure the two concepts from which this subscale originated.

6.11 PEOP Scale Analysis

The next part of this chapter will discuss the analysis performed using the PEOP scale within this study sample. Analysis of the results is performed by combining the two different datasets from sample one and sample two. Prior to analysis descriptive statistics and scores of both samples are presented.

Descriptive statistics and scale and subscale scores for the EFA (n=282) and CFA (n=446) samples are shown below in Table 55. Within the EFA sample, all subscales produced a good range of values, with three subscales encompassing the entire range possible. Similarly, the total scores encompassed most of the range, though no participants scored the absolute minimum or maximum. The good range of scores for each of the four subscales, across both samples, indicates that the scale is sensitive

enough to capture individual differences in responses to subscale and total. The results demonstrate that the range of scores for total scale and subscales were largely similar across the two samples. Within the CFA sample, the mean total score and subscale scores, with the exception of subscale four, were marginally higher than those within the EFA sample.

Table 55 Descriptive statistics and scale scores – EFA AND CFA Sample

							Quartiles		
		Mean	**SD**	**Range**	**Min score**	**Max Score (Total possible)**	**25th**	**50th**	**75th**
Subscale 1	EFA	12.20	7.36	31	6 (6)	37 (42)	6	10	13
	CFA	14.96	7.98	33	6 (6)	39 (42)	9	12	20
Subscale 2	EFA	15.95	6.61	30	5 (5)	35 (35)	11	15	20
	CFA	18.06	6.44	30	5 (5)	35 (35)	13	18	23
Subscale 3	EFA	21.71	6.84	29	5 (5)	34 (35)	16	23	27
	CFA	23.69	6.29	27	8 (5)	35 (35)	20	24	28
Subscale 4	EFA	8.80	3.84	16	3 (3)	19 (21)	6	8	11
	CFA	7.86	3.69	18	3 (3)	21 (21)	5	7	10
Total scale	EFA	58.62	12.94	74	26 (19)	100 (133)	49	59	66
	CFA	64.56	12.85	74	30 (19)	104 (133)	56	64	74

Lower, median and upper quartile scores were also calculated and again, as seen in Table 55, the subscales were broadly consistent across the two samples. Wider variation between the two samples was seen in the total scale score. The results suggest that for the total scale score, although some participants endorsed the higher end (100 in the EFA sample and 104 in the CFA), the majority of participants (75%) scored approximately seventy for the whole scale. The absolute scores of the subscales and their interpretation are discussed in more detail in Chapter seven.

Existing qualitative research and findings of study one suggests that factors such maternal BMI, infant age and infant feeding method, may influence parents' perceptions of infant overweight, which in turn may have a negative impact on engagement in obesity prevention. In order to explore any possible associations, demographics of parents within this study and responses to the scale, non-parametric tests were

performed on a combined dataset of the EFA sample (n=281) and CFA sample (n=446). Due to the low intercorrelations between the four subscales, which suggests that the subscales are conceptually unique, statistical analyses examined were performed on the four individual subscales as well as the total scale score. How each of the variables related to the scale and the four subscale scores, is discussed in more detail below.

Infant Age (and timing of risk communication)

Study one findings indicated that infant age or stage of development may influence parental engagement in behaviour change to modify infant feeding practices, with weaning age, around six months considered the most acceptable time (subtheme 3b). Prior to this, reducing infant formula or breastmilk was perceived as denying a child of their nutritional needs and presented challenges and resulting feelings of guilt.

Given these findings, it was predicted that scale scores, in particular subscale three, drive to feed, may be higher amongst mothers with younger infants. Spearman's correlation coefficient was used to measure the relationship between infant age and scores. The four age categories were infants 12 weeks of age and under, 13-26 weeks, 27-39 weeks and 40-52 weeks. Tests were performed on the total score and each of the four subscales. There was a significant relationship between infant age and engagement as measured by the total score of the PEOPS. As infant age increased, the scale score decreased, suggesting decreasing barriers to engagement ($r = -.16$, $p<0.01$). A significant association was also found between infant age and subscale two, knowledge of consequences and tracking of overweight in infancy ($r= -.10$ $p<0.01$) and subscale three, drive to feed ($r=-16$, $p<0.01$). Subscales one, fear of judgement and four, confidence to recognise infant overweight, showed no significant associations.

Maternal BMI

Redsell and colleagues identified that maternal BMI may influence maternal receptiveness to identifying their infant as overweight, with overweight mothers more reluctant to do so than their healthy weight counterparts (Redsell, et al. 2010). Although there was no apparent difference in responses in relation to receptiveness to risk communication between overweight and healthy weight participants in study one, these were explored using correlations. Spearman's correlation coefficients for the total scale score and subscales one, three and four did not demonstrate any significant associations in responses in relation to BMI. However, scores for subscale two, were significantly correlated ($r= .10$, $p<0.01$) and as maternal BMI increased, subscale scores increased. This suggests that within this sample, overweight and obese mothers had a

lower level of awareness of the consequences and tracking of infant overweight in comparison to their healthy weight counterparts.

Infant feeding method

Parents within study one cited overfeeding as the primary cause of infant overweight. Despite this, there was the perception that a breastfed baby was unable to become overweight, and that this is more likely amongst formula fed babies. These perceptions may have a negative implication for engaging parents, particularly those who are breastfeeding, when it comes to assessing obesity risk and modifying infant feeding practices. Difference in scale scores were assessed with the expectation that mothers who formula -fed their infant versus those who breastfed, would differ, with higher scores expected amongst breast feeding mothers, particularly in relation to drive to feed, subscale three. The Mann-Whitney test (Mann and Whitney, 1947) was used to assess differences between the responses of formula feeding mothers (Grp 1 n=292) or breastfeeding mothers (Grp 2 n=377). The equation by Rosenthal (1991) was used to convert the z-score into effect size and size interpreted using Cohen (1988).
Results showed a highly significant difference in scores from formula feeding (Mean = 18.23 SD=6.52) and breastfeeding mothers (Mean = 16.34 SD=6.60) for subscale two, knowledge of consequences of infant overweight ($z = -3.79$, $p<0.001$, $r=-0.15$). In subscale two, scores were lower in breastfeeding mothers within the sample and low scores were more numerous compared to those of formula feeding mothers. This suggests that knowledge of the consequences and tracking of infant overweight were higher amongst breastfeeding mothers, which is hypothesised as positively influencing engagement. As predicted, there was also a significant difference in response between formula (Mean = 18.46 SD=5.78) and breastfeeding mothers (Mean = 26.28 SD=5.00) for subscale three, maternal drive to feed ($z = -15.31$ $p<0.001$, $r= -0.59$). The scores of subscales three, drive to feed, were significantly higher amongst breastfeeding mothers compared to those who formula- fed their infant. This suggests that breastfeeding mothers within this sample had a stronger drive to feed, suggesting that greater barriers may exist to engage breastfeeding mothers in modifying their infant feeding practices.

First time parenthood

As discussed in Chapter two, the transition to parenthood has been identified as both an enabler and barrier to engagement during infancy, (defined as programme attendance) (Love, et al. 2018). Engagement is thought to be mediated by first-time parents' need for information about infant feeding (Love, et al. 2018), as well as a desire for social interactions with other parents (Kelleher, et al 2017). The desire for information and

reassurance around infant feeding, particularly in relation to weaning, was mirrored in the discussions of parents from study one (subtheme 3b). However, it was unclear if this was exclusive to first time parents. In order to explore any difference in the scale scores between first time mothers (Grp 1: n=416) and those who were already mothers (Grp 2; n =311), a Mann-Whitney test (Mann and Whitney,1947) was utilised. Results demonstrated that responses of first time and other mothers only differed significantly for subscale four, self-efficacy to identify infant overweight ($Z = -2.96$ $P<0.005$, $r= -0.11$). Scores were higher amongst first time mothers, which suggests that they have lower levels of self-efficacy to identify their infant as overweight, compared to mothers who have more than one child.

Within this sample, infant gender was not found to be related to engagement, with responses to all subscales and the total score showing no significant difference. This was the same for maternal age.

6.12 Conclusion

The aim of the second part of study two was to examine and confirm the factor structure and psychometric properties of the new PEOP scale. The confirmatory factor analysis resulted in confirmation of the four constructs identified in the exploratory analysis. The PEOP scale is a psychometrically sound measure of parental engagement. The 19 item, four-factor scale is a reliable scale measuring the multifaceted construct through four conceptually unique subscales: fear of judgement about infant weight; awareness of consequences of infant overweight; drive to feed; and perception of efficacy to recognise their infant as overweight or obesity.

The PEOP scale showed a possible negative association between engaging breastfeeding mothers in modifying infant feeding practices. In most cases, the effect sizes were small, with the exception of the drive to feed (subscale three) and feeding method which was medium. Results should therefore be interpreted with caution. As predicted, low infant age negatively influenced engagement as a total score, showing that the ‘drive to feed’ is higher amongst those with younger infants, suggesting that there may be barriers to engaging parents in the modification of infant feeding practices. The findings also suggest that maternal BMI positively influenced the level of awareness of the consequences of tracking infant overweight. The results also suggest that there may be more barriers to engaging breastfeeding mothers compared to those who are formula feeding. Lastly, first-time parenthood appeared to negatively influence

engagement due to increased fears of judgement and lower self-efficacy to recognise infant overweight.

Chapter Seven
Discussion and Conclusions

7.1 Introduction

This chapter discusses and concludes this mixed method project to develop a new scale to measure parental engagement in the early prevention of childhood obesity. The chapter begins with an overview of the thesis before summarising its findings. Following this, the Parental Engagement in Obesity Prevention (PEOP) scale is discussed in detail. This includes discussion of the scale and subscale scores within this sample, presented in Chapter six. The focus begins with the composite scale and recommendation for further research, followed by a discussion of each subscale. For each subscale, scores are discussed in relation to existing evidence, as well as in terms of using each subscale within clinical practice and any further research. The chapter concludes by discussing the study's limitations and strengths.

7.2 Overview of thesis

The aim of this research was to explore parents' beliefs in relation to obesity risk assessment during infancy, to inform the development of a new scale to assess parental engagement with obesity prevention. There were two main stages to this mixed methods design. Firstly, parents' beliefs about infant overweight and receptiveness to the assessment and communication of the future obesity risk during infancy were explored qualitatively (study one). Secondly, study one findings were utilised to inform the development of a new measure of parental engagement (the PEOP scale) and then assess the psychometric properties of the scale (study two). As discussed in Chapter three, the strength of mixed method complementarity design rests upon the integration occurring at different points in the research process. The strengths of qualitative methods are used to enhance or improve the performance of the quantitative phase of the research (Morgan, 1998). Therefore, the results of study one, discussed in Chapter four, are independent within their own right; in other words, the findings have internal validity whether or not they became part of the scale. This complementary design was chosen for the purposes of scale development and to gain an in depth understanding of parents' beliefs in order to inform the development of new constructs for this scale.

The thesis began with an introduction and overview to childhood obesity in Chapter one, followed by Chapter two, which reviewed the existing literature relevant to this project. This included evidence of the early life risk factors of childhood overweight and obesity, obesity risk prediction tools, interventions to prevent obesity, parental engagement and current perceptions of infant overweight and obesity risk. Chapter three then presented the health belief model as the theoretical framework for the thesis. While there is a plethora of evidence relating to early life risk factors of childhood overweight (Woo Baidal, et al. 2016) and early preventative interventions (Redsell, et al. 2015; Matvienko-Sikar, et al. 2018), less is understood about the perceptions of parents regarding infant weight and obesity and their role in prevention. Chapter four presented study one in which qualitative interviews were conducted with 19 parents of infants and in which their views on infant overweight and the identification of future risk, were explored. Three main themes and associated subthemes emerged from the analysis: 1) the identification of infant overweight and future risk, 2) the consequences of infant overweight status, and 3) parental attributions of causality, responsibility, and control. It became evident from the study that a number of factors influenced parents' receptiveness to the idea of a hypothetical risk communication intervention and intervention to modify infant feeding practices, in particular, infant age: specifically, weaning and walking age, by which time, opportunities for early prevention may be missed.

Chapter five described the process undertaken to identify constructs for inclusion within the new instrument to measure parental engagement in obesity prevention. Constructs were informed by both study one findings and the conceptual framework of the thesis. This resulted in the development of six overarching constructs for inclusion: 1) self-efficacy to prevent overfeeding/influence weight through feeding, 2) guilt and self-blame in relation to infant weight and guilt associated with reducing milk/food, 3) self-efficacy with regards to identifying infant overweight, 4) fear of judgement, 5) perception of health and other related risks of obesity and 6) perception of causal attributions for infant weight (locus of causality). The later part of Chapter five described the process of developing a pool of 95 items to capture the six constructs and assessment of the content validity of the item pool by experts, prior to being completed by parents. Chapter six presented study two, in which a measure of parental engagement in obesity prevention was constructed using factor analysis.

Exploratory factor analysis was performed prior to a confirmatory analysis, to assess dimensionality. For the EFA, the measure was made available to mothers of infants via an online forum out of which a sample of 252 was used. As a result of this process, a

four-factor solution emerged, comprising four constructs, each with between three and six items and an overall total of 19 items. The internal consistency of each subscale was acceptable (α = .79 - .92). To confirm its factor structure the model was then subjected to a CFA with a new sample of mothers (n=446). . The CFA resulted in a 19 item scale with four subscales: 1) maternal fear of judgement about infant overweight; 2) maternal awareness of the consequences and tracking of infant overweight; 3) maternal drive to feed and; 4) maternal self-efficacy with regards to identifying infant overweight. The absolute scores of the PEOP scale within this sample were presented as were the results of the statistical analysis performed within a combined sample, to assess the associations between the demographics of the sample and each of the subscales.

7.3 Summary of core findings

Mothers within this sample did not indicate having any concerns about being judged about their infants' weight and also felt confident with regards to recognising if their own infant was or was becoming overweight. However, they had a strong drive to feed and did not perceive there to be any health consequences of infant overweight or the tracking of infant overweight.

The differences in responses dependent on demographic factors, were seen across the subscales, and are summarised below:

- Breastfeeding mothers had a greater perception of health risk and tracking of infant weight than formula feeding mothers.
- Breastfeeding mothers had a higher drive to feed than formula feeding mothers.
- Mothers of younger infants had a higher drive to feed compared to those of older infants.
- Mothers of younger infants had lower perceptions of health risk and tracking of infant overweight compared to mothers of older infants.
- Overweight or obese mothers had a lower perception of the health risks and tracking of infant overweight compared to healthy weight mothers.
- First time mothers had a lower self-efficacy with regards to identifying their infant as being or becoming overweight compared to mothers of multiple children.

7.4 The Parental Engagement in Obesity Prevention (PEOP) Scale

The PEOP was developed to measure factors that may influence parental engagement in the early prevention of childhood obesity. This includes but is not exclusive to, factors influencing all areas of engagement, for example: acknowledgement or recognition of infant overweight status; recognition of health risks; conversations about infant weight; or intervention to modify infant feeding practices.

The new PEOP scale showed a good model fit within this sample of mothers and is therefore deemed to be a valid and reliable tool. The composite scale showed good reliability, as did each of the subscales, enabling them to be used independently. However, validation of a new scale such as the PEOP is an iterative process (Devellis, 2003) and therefore, further research to validate the scale is recommended. Further CFA should also be conducted to assess the goodness of fit and to measure subscale correlations with different participants and population groups. In particular, it would be useful to assess the validity of the PEOP within a more diverse sample, such as one that includes younger mothers, mothers of infants from ethnic minority groups or those of a lower socioeconomic status. Confirmatory factor analysis within a different sample will allow confirmation of its divergent validity. Assessment of validity against other instruments is also recommended. As discussed, there are no existing composite scales that could be utilised, but constructs measured by individual subscales could possibly be measured against existing instruments that measure similar constructs. For example, subscale three and the Infant feeding style questionnaire, or more generic scales measuring constructs such as maternal guilt (Martinez, et al. 2011; Kuhn and Carter, 2006). Following this, further research should be performed to understand the predictive ability of the PEOP scale.

The composite scale provides a good range of values (Table 55). A maximum score of 104 out of a possible 133 indicates that the subscale was able to identify participants who scored highly. For the overall scale, the higher scores indicate agreement with the statements from subscales one, three and four and disagreement for subscale two. A higher score is indicative of a fear of judgement, low awareness of the consequences of infant overweight, a drive to feed and low self-efficacy in terms of recognising infant overweight, all factors that may have negative influence and act as a barrier to parental

engagement in the early prevention of childhood obesity. Within this study, sample quartile ranges and mean scores (Table 55) indicate that most scores for the CFA sample were 74 with a mean of 64.56. This indicates a low to moderate overall score. Within this sample of mothers, a positive finding was that they did not indicate concerns about being judged about their infants' weight and felt confident about recognising if their own infant was or was becoming overweight. However, they had a strong drive to feed and did not perceive there to be any health consequences to infant overweight or the tracking of infant overweight. These findings present a mixed picture, with the latter two factors presenting possible barriers to engagement and the former being potentially beneficial for engagement. The low correlation between the four latent factors (Figure 14) suggests that they each act independently as conceptually unique and distinct measures of different aspects of parental engagement, which is a multi-faceted construct. To date there is neither a theory nor evidence to suggest a relationship between these four constructs, so no correlation was expected, and the results were unsurprising. As discussed previously, parental engagement is still a relatively new area of research so concepts and constructs are relatively underdeveloped and further studies are needed to understand the constructs of engagement and the relationship between them. Results are therefore discussed for each of the subscales individually. The absolute scores and differences in scores between parents within this sample are discussed, along with how the findings relate to the existing literature. Discussion includes uses for the scale in clinical practice and directions for future research.

7.4.1 Subscale one: maternal fear of judgement

Subscale one is a six-item scale measuring maternal fear of judgement about infant overweight, in which the higher the score, the higher the fear of judgement, with a maximum total score of 42. The upper quartile of scores were 13 within the EFA sample and 20 within the CFA sample (Table 55). These scores were low to moderate, suggesting that most mothers disagreed with the statements about having concerns of being judged about their infants' weight status. Maternal fear of judgement about infant weight has not been quantitively examined before, but within the existing qualitative research, concerns about being judged have been reported (McKee, et al. 2010; Redsell, et al. 2010; Bentley, et al. 2017). Parents within these studies describe a fear of judgement and criticism from health professionals, peers and family. Reasons discussed relate to stigma and shame and being seen as a bad parent (Redsell, et al. 2010; Bentley, et al. 2017). Given the scale's performance, it is reasonable to assume that the low subscale scores within this study might be explained by the demographics of the sample, in that the majority of participants were older (30-35 years old), well

educated, white mothers with a professional employed status. Although the scores from most of the sample did not indicate concerns about judgement, a maximum score of 39 out of 42 demonstrates that the scale did identify some higher scores and agreement with statements, so there were concerns for some mothers. From the qualitative research, it is not possible to quantify or conclude if fear of judgement is something reported by all parents or just some. Further research is required to understand this. Within this study sample, no differences were found between the responses of mothers of a different weight or age, infant's age, gender, feeding method or first-time parenthood. Further research to validate and understand how factors such as maternal or infant BMI may influence the fear of judgement, is needed. Within the adult literature, feeling judged or criticised by a health professional has also been reported by overweight and obese mothers (Furber and McGowan, 2011; Cunnigham, Endacott and Gibbons, 2018). Within the literature on eating disorders, the fear of judgment has been associated with BMI and a high BMI is recognised as a risk factor for fear of negative evaluation (FNE) (Levinson and Rodebaugh, 2012). It should be noted that fear of judgement discussed by adults about their own weight may differ from fear of being judged about the weight of their infant.

Theoretically, a fear of judgement may act as a perceived barrier to seeking support, particularly if outweighing the perceived benefits of change (Rosenstock, Strecher and Becker, 1988). Within this sample, the results are positive, as judgement was not fear for the majority, but for mothers scoring highly on this scale, this may be a barrier to engagement. For example, it could have a negative influence upon a parent's willingness to acknowledge infant overweight or to seeking support or guidance from a health professional. This is something discussed by Jain and colleagues who propose that fear of being judged as a bad parent may cause reluctance in parents to acknowledge their child as being overweight (Jain, et al. 2001). Reports of judgement amongst parents about their child's weight is not surprising, given that we live in a society in which parents are commonly blamed for their child being overweight (De Brun, et al. 2013). Judgement is also seen from other parents (Appleton, Fowler and Brown, 2014) and health professionals (Puhl and Heuer, 2009; Mold and Forbes, 2013; Schwartz, et al. 2003). Paradoxically, concerns are also evident from health professionals who feel hesitant about raising the issue of overweight, due to concerns that it may appear judgemental (Rose, et al. 2019).

Within clinical practice, the new scale could be used with mothers of infants either universally or amongst those that may be identified at higher risk of childhood obesity to

identify higher scoring mothers. The use of the scale in practice may also help to increase awareness of the fears perceived by parents, thereby supporting effective and non-judgemental conversations about weight, in which overweight is framed in the context of the obesogenic environment and reducing inference of personal blame and responsibility, particularly with parents that identify as being concerned about judgement.

Existing literature on the fear of judgment relates to anxiety about physical appearance in patients with eating disorders (Levison and Rodebaugh, 2012). Fear of negative evaluation (FNE), which is thought to be a core feature of social anxiety, has also been shown to be higher amongst children with higher BMI z-scores ($P<0.01$) suggesting that an enhanced weight in children may be a risk factor for FNE (Hartmann, et al. 2010). Parental fear of judgement in relation to childhood overweight and obesity has been previously noted but existing research relates primarily to the fear of the child being judged or bullied by others and not the fear of judgement about parenting competence. These findings support the limited literature in this area and expand upon those of Redsell and colleagues (Redsell, et al. 2010) in which parents raised concerns about the stigma and shame associated with having an overweight child and fears of criticism by others (Redsell, et al 2010), leading to reluctance of mothers to acknowledge their child as being overweight.

Further research should be carried out to understand more about the factors that underpin misconceptions, and the role fear of judgement plays in this. Within research, this subscale could measure fear amongst larger and different groups of mothers of infants, to learn more about how fear of judgement may differ between different groups of mothers. For example, it would be interesting to compare the results of this study within younger or less educated mothers to identify if fear of judgement is more prevalent. Within this sample, there was no association between maternal BMI and fear of judgement, but this may reflect the overall lower scores and demographics of the sample. Therefore, the association should be explored within a different sample as should any associations with infant weight.

7.4.2 Subscale two: maternal awareness of the future consequences and tracking of infant overweight.

Subscale two is a five-item scale measuring maternal awareness of the consequences and future tracking of infant overweight. A high score indicates disagreement with the statements and low awareness of the future consequences and tracking of infant

overweight, which may have negative implications for engagement. The highest score achievable for this subscale is 35; the upper quartile of responses (75%) indicated a score of 23. The results suggest that parents within this sample disagreed with the statements, indicating poor acknowledgement of future health consequences as a result of being an overweight infant or toddler, or that infant overweight can track into later childhood. To date, most of the existing research on perceptions of health risks amongst parents supports these findings that perceptions are poor, although the research is focused on parents of older children (Etleson, et al. 2003; Cottrell, et al. 2007; Park, et al. 2013). Current qualitative research also suggests that parents do not associate infant overweight with health risks. In a study by Redsell and colleagues (2010), parents of infants did not articulate any concerns about or awareness of, health risk associated with obesity Instead, underweight in infancy is perceived to be more problematic for health (Redsell, et al 2010 Lakshman, et al. 2012).

Within this sample, responses were influenced by infant age. As an infant became older, subscale scores decreased, suggesting that maternal awareness of the future consequences and tracking of infant overweight into childhood was higher amongst mothers of older infants. These findings support existing research that infant's age or stage in development is a key influence in terms of the point at which parents acknowledge overweight as possible, view it as a cause for concern and become receptive to identification of overweight status or assessment of future risk, with walking seen to be a particularly significant milestone (Redsell, et al. 2010; Bentley, et al. 2017; Dinkel, et al. 2017). Prior to infant walking age, when an infant is around a year old, parents stated that any risk results would not be deemed believable and were likely to be dismissed (Bentley, et al. 2017). Within the literature on older children, perception of a health risk was associated with recognition of the child being overweight (Park, et al. 2013). This provides some explanation for low perceptions of risk and parents' rejection of the idea that an infant can be overweight.

Feeding method also influenced the responses to this subscale, with breastfeeding mothers scoring lower than mothers who were formula feeding. This suggests that breastfeeding mothers agreed with the statements, demonstrating a greater awareness of the future consequences, and tracking of infant overweight than the formula feeding mothers. The perception of health risk amongst the breastfeeding mothers is interesting: in some ways it refutes the qualitative literature with regards to parental perceptions that it is possible for a breastfed baby to be overweight (Lakshman, et al. 2012; Dinkel,

et al. 2017) and that breastfed babies are protected from overfeeding, excess weight and future risk of obesity (Rose, et al. 2019).

As well as the influence of breastfeeding and infant age, maternal BMI also affected scores, with overweight and obese mothers scoring higher than those of a healthy weight. This suggests that overweight mothers were less likely to acknowledge the future health risks and tracking of infant overweight than their healthy weight counterparts.

The theoretical link between risk perception and engagement in behaviour change is well established (Becker, 1974), and there is growing literature to support this theory in relation to childhood obesity (Alexander, et al. 2017) as there is amongst adults (Post, et al. 2011). Alexander and colleagues have hypothesised that an increased perception of childhood obesity risk factors and health complications would be associated with greater caregiver support for obesity prevention. The study found that although perceptions of the risk factors and health complications of obesity were moderate, a significant association was found between knowledge of health complications and a support for prevention (Alexander, Alfonso and Cao, et al. 2017). Within the wider literature, perception of risk has been associated with parental engagement in parenting programmes (Cunnigham, et al. 2000) as has recognition of severity of a health condition (Reid, Webster-Stratton and Baydar, 2004). Within the literature on the engagement of parents of infants in early childhood development interventions, infant health status has been shown as a predictor of maternal engagement (Kazdin, Holland and Crowley 1997; Kuchler-O'Shea, Kritikos and Kahn 1999).

The PEOP scale provides an invaluable tool to help identify parents of infants who are not yet aware of the consequences of infant overweight and/or do not perceive their infant to be at future risk of childhood obesity. Identifying these parents will allow for them to be targeted for interventions to raise awareness.

As discussed above, infant weight was not assessed within this study. Future research should explore how infant weight influences this subscale and determine if BMI is related to perception of health risks and engagement, as shown within slightly older children (Warshburger and Kroller, 2012). The study by Warshburger and Kroller (2012) showed that amongst mothers of children as young as two years old, perception of health risk and willingness to engage in prevention efforts did not occur until a child was on or above the 97th centile. In relation to this particular subscale, it would also be useful

to explore the significance of infant age on parents' risk perceptions. Within this study, sample perceptions increased with infant age, but data was only collected from mothers with children up to one year or under. Further research should use the scale with mothers of infants over a year old, in order to identify whether these associations continue with older infants and to verify the qualitative findings regarding whether perceptions around health and risk are seen as insignificant until walking age.

7.4.3 Subscale three: drive to feed

Subscale three is a five-item scale measuring maternal drive to feed. The subscale includes items that capture the challenges of coping with an infants' perceived demand for feeding, feeding to help sooth or to help their infant sleep, and anticipated feelings of guilt related to reducing formula or breast milk. The higher the subscale score, the higher the level of agreement with the statements. Within this sample, the upper quartile score was 28 out of a total possible score of 35 (Table 55), indicating agreement with the items. This reflects the difficulty of resisting an infant's demands to be fed or soothed, and anticipated feelings of guilt to reduce formula amongst these parents. Feelings such as these may act as a barrier to parents' willingness to engage in positive infant feeding practices and interventions. Although there are no known reports of guilt as a direct result of formula milk reduction within the existing literature (Guell, et al. 2018), these findings support those of other studies in which guilt in relation to infant feeding is an emotion commonly expressed by mothers (Lee, 2007; Lakshaman, Ogilvie and Ong, 2009; Hoddinott, et al. 2012; Thomson, Ebisch-Burton and Flacking, 2015).

Some argue that guilt is an adaptive and constructive emotion that motivates compensatory behaviours to alleviate the source of the guilt (Tangney, Stuewig and Mashek, 2007). One study explored the influence of guilt on child feeding choices by providing parents of four to five-year-old children with family history information-based obesity risk feedback to parents. The receipt of obesity risk information to parents increased both lifestyle and genetic-related guilt. These emotions of guilt were proposed to result in the choice of fewer unhealthy foods for their children, which decreased both genetic and lifestyle related guilt (Persky, et al. 2015). Interventions to promote maternal guilt such as these are controversial: in line with the health belief model, emotions of guilt and shame are perceived as barriers to interventions. The significance of emotions of guilt upon parental engagement in obesity prevention are yet unexplored.

Responses to the other items within the scale suggest that mothers within this sample fed their infant to help them to sleep or to soothe them when crying. Feed to soothe

(FTS) is discussed within the literature and is described as feeding to regulate or calm emotions and feeding in response to distress that is unrelated to hunger (Baughcum, et al. 2001; Stifter and Moding, 2015). The impact of these feeding practices upon parental engagement has not been explored however Lakshman and colleagues (2012) discussed a reluctance to reduce formula milk amongst parents. Reluctance was primarily due to practical concerns such as the baby crying, waking up in the night, being hungry, and demanding more feeds highlight the potential barriers to early preventative intervention.

Within this study sample, responses differed with infant age and as age increased, scale scores decreased. This suggests that anticipated feelings of guilt and perceived challenges to resisting infant demands for food or soothing to lessen as an infant becomes older. These findings possibly concur with other qualitative studies in which receptiveness of the idea of reducing infant milk became more acceptable to parents when they were around weaning age and milk was not their only source of nutrition (see for example, Bentley, et al. 2017). Conversely, some parents from the Baby Milk Trial articulated that modification to feeding practices to reduce formula milk would have been easier if started within the first few weeks of feeding (Guell, et al 2018). Responses from breast and formula feeding mothers also differed, with significantly higher scores seen in breastfeeding mothers. This suggests that they were more likely than formula feeding mothers to use food to calm their infant and get them to sleep, and anticipated guilt in response to reducing infant milk. Within qualitative studies, perceptions about overfeeding and susceptibility to infant weight gain also appear to be influenced by feeding method, with many perceiving that breastfed infants cannot be overfed, be overweight and the belief that these infants are protected from the risk of future obesity (Lakshaman, et al. 2011; Dinkel, et al. 2017; Rose, et al. 2019). This perception is one that seems to be held by all mothers, not just those who are breastfeeding, and is concerning given that the risk of rapid weight gain is evident in both breast and bottle fed babies (Rzehak, et al. 2017). These findings also highlight the influence that such perceptions can have on awareness of susceptibility and engagement in intervention.

Although some argue that bottle feeding imparts a greater risk than breastfeeding, given that only 24% of mothers exclusively breastfeed by the time an infant reaches six weeks old, falling to 1% by six months (Infant Feeding Survey, 2010), it is evident that most infants in the UK will still be bottle or formula fed at some point. The drop off between initiation of breastfeeding and length of continued exclusive breast feeding and

the equivocal risk of weight gain, highlight the importance of engaging formula and breastfeeding mothers in intervention. Given that the majority of mothers either revert to formula feeding or mixed feeding, it is evident that most infants will be fed using either with formula milk or bottle fed with breastmilk. These figures also demonstrate the significance of infant feeding interventions to support parents to develop responsive feeding skills.

Subscale three differs from the other subscales in that it relates more to parental engagement in modification of feeding practices to reduce rapid weight gain, rather than engagement in the initial conversations about infant weight and future obesity risk. As discussed within Chapter two, maternal responsiveness and recognition to infant cues are key components of responsive feeding interventions (Black and Aboud, 2011; Paul, et al. 2011; Daniels, et al. 2012, 2013). As discussed within that chapter, obesity prevention interventions, that include components of responsive feeding, have demonstrated positive outcomes, (Redsell, et al. 2015; Matvienko-Sikar, et al. 2018). Recent evidence from the Baby Milk Trial is also positive: mothers' attitudes were seen to shift in terms of embracing the possibility that babies can be fed too much. There was also an increase in confidence levels with regards to feeding their infant appropriately in order to prevent excessive weight gain (Lakshman, et al. 2018). Current interventions for obesity prevention are promising and engaging parents in such interventions is a priority. The scale discussed in this thesis could be used in practice to identify mothers who may score highly, such as those within this study, and who are therefore less likely to engage in behaviour change. This means that mothers who would benefit most from the intervention can be identified and supported to develop positive feeding practices during early infancy.

As discussed, most of the mothers within this study were between 30-35 years old and the majority were first time parents, suggesting that they were above the average age for a first-time mother in the UK (Office of National Statistics (ONS) 2017) of 28. The results from this study did not show any significant association between response to this scale and maternal age but this may be because the overall sample comprised b older mothers. Further research should explore the influence of maternal age upon these findings by validating the scale within a sample of younger mothers. Furthermore, in this particular sample, mothers predominately breastfed, and 14% reported exclusively breastfeeding until 6 months of age (Table 47), which is way above the national average. The influence of the sample demographics upon this should be considered and the scale should be validated with other groups of mothers.

The influence of infant age upon these perceptions and behaviours, as captured in subscale three, also warrants further exploration so that more is understood about most acceptable time for engagement as perceived by parents.

7.4.4 Subscale four: maternal self-efficacy to recognise infant overweight

The final subscale has three items that measure self-efficacy in terms of recognising overweight or obesity in infancy. A high score suggests agreement with the statements and low self-efficacy in recognising infant overweight. Upper quartile scores were 10 within the CFA sample and 11 within the EFA sample, out of a possible total of 21 (Table 55). This suggests that this particular group of mothers felt confident that they would be able to identify if their own baby was overweight or obese and would not require support from a health professional to help ascertain whether or not their baby was becoming overweight. Although parental recognition of infant weight status is well researched (Brown, et al. 2016; Harrison, et al. 2018) as is self-efficacy, this is the first study to explore this specific domain of self-efficacy.

Parents' confidence to recognise or identify their infant as overweight is a new area of research and it is therefore difficult to compare these finding with existing research. Theoretically, the recognition of overweight status or perceived susceptibility to overweight is necessary for behaviour change (Rosenstock, Strecher and Becker, 1988), so these reported levels of confidence in identifying infant weight are likely to be positive for behaviour change. Recognition of the child's overweight status has also been linked to perceptions of health risks of obesity (Park, et al. 2013). For this subscale, mothers' responses differed between first time mothers and those who already had children, with significantly higher scores amongst first-time mothers. This suggests that first time mothers had lower self-efficacy in terms of identifying infant overweight and obesity. These findings support the wider literature on parenting efficacy that identifies lower levels of self-efficacy in first time, less experienced mothers (Drake, et al. 2007; Ngai, Chan and Holroyd, 2007; Salonen, et al. 2009).

The wider domain of self-efficacy is another important determinant of health behaviour change (Bandura 1986), including those who support the prevention and management of childhood obesity (Taveras, Mitchell and Gortmaker, 2009; West and Sanders, 2009). Self-efficacy also underpins models of parental engagement (Samra, et al. 2015; Piotrowska, et al. 2017), and is recognised as important within maternal engagement in both sustained and exclusive breastfeeding (Blyth, et al. 2002; McCarter-Spaulding and Gore, 2009). . Within this study's sample, the maximum scores of 19 and 21 indicate

that there were parents who were not so confident, and it is these parents who may require additional support to reduce this as a barrier to engagement. This subscale will provide an invaluable tool for use in clinical practice to improve parental perceptions about and acknowledgment of, infant overweight. Specifically, it supports the identification of mothers who are not confident in recognising their infant as being or becoming overweight and who may benefit from support to do so.

Aside from future research being conducted within a different sample as discussed above, the construct of self-efficacy could inform further research to explore its role in parental engagement in obesity prevention intervention such as those discussed by Love and colleagues. Predictors of engagement are thought to vary across the different stages of a programme and therefore, different strategies may be required at different times to support families (Eisner and Meidert, 2011; Hackworth, et al. 2018). It may be that higher self-efficacy amongst parents is not a predictor of enrolment in a programme but is significant, as already recognised, in terms of supporting sustained behaviour change.

7.5 Study strengths and limitations

Strengths and limitations of study one and two are discussed in more detail within their respective chapters (four and six). This section will address the overall strengths and limitations of this mixed methods research project. Complementarity study design (Morgan, 1998) is used to enhance or improve the performance of the quantitative phase of a research and this design worked particularly well for this project. The use of qualitative data to inform the development of the concepts for this new scale is a particular strength of this study: in the absence of existing literature on predictors of parental engagement in childhood obesity prevention, the use of this data to inform the constructs of this scale was considered essential to ensure that constructs were informed by parental perceptions not those of the researcher. The use of the health belief model as its conceptual framework for the development of this scale is also considered a strength and something that sets it apart from other studies on parental engagement in childhood obesity which lack theoretical frameworks. Another strength was the relatively large sample sizes for the factor analysis, the CFA (n=446) which exceeded the recommended 300 participants determined at the start of the study. The entirety of the sample and its online nature allowed for a collection of data from across the UK, providing a more diverse sample than may have been captured from East Anglia alone. It should however be acknowledged that in both study one and study two

samples, black, Asian and minority ethnic (BAME) communities are poorly represented, something not unique to this research. The study two sample was representative of UK levels of overweight and obesity, however, with 25-26% participants being obese (including morbid obesity), which is slightly under-representative of obesity prevalence in the UK of 30%. The study one sample was more representative in relation to average female BMI and level of education.

It should also be noted that the factor analysis sample was only based on the mothers, so the scale is not currently valid for use with fathers of infants. A further limitation of the research findings is the hypothetical nature of some of the research questions. In many cases, participants voluntarily personalised the questions to be in relation to their own infant; however, when discussing the anticipated consequences and benefits of being told about future obesity risk, responses were hypothetical. A further limitation is the lack of information about infant weight status in the study two sample. Self-reported data regarding infant weight centile data was collected for some of the sample but infant lengths were not collected. This was due to the original intention to use data to assess the future risk of overweight using the IROC checklist (Weng, et al. 2013 so infant length was not originally deemed as necessary. Furthermore, the calculation of an infants' individual risk status without consent was not ethical. Data on parents' perception of their infants' current weight status was also collected but could not be utilised without information on infant weight status and time did not allow for the use of the data. This was primarily due to underestimating the time it would take to undertake a mixed methods study and the rigour expected when developing a psychometric tool. Small to medium effect sizes of associations, mothers and the subscales should also be noted as a limitation.

7.6 Conclusion

This thesis offers a new valid and reliable measure of parental engagement in the early prevention of childhood obesity. The new measure is unpinned by both quantitative research of parents' perceptions and a theoretical framework. The scale is designed for use with mothers of infants and measure factors that may influence parental engagement. This is the first scale to measure parental engagement in childhood obesity. This scale identified four conceptually unique constructs: maternal fear of judgement about infant weight; maternal awareness of consequences and tracking of infant overweight; maternal drive to feed; and maternal efficacy to identify infant overweight. An understanding of factors that influence engagement and a scale to

measure these constructs, allows for those parents who have these beliefs/hold these perceptions to be identified and supported or targeted for interventions that may minimise barriers to engagement. Understanding these factors provides invaluable insight to support clinical practice, determine solutions and support and enable parents to engage in efforts to prevent childhood obesity; the PEOP scale provides a valuable new tool to both inform practice and future research.

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Appendix A – Letter to Children's Centre

27/02/14

Dear Faye

This letter acts as confirmation that we agree for you to use our children's centre as a study site to support the recruitment of parent volunteers for your PhD study. We understand that in agreeing to be involved you will be recruiting parents who attend the centre. At no point will we be asked to share personal or identifiable details of individuals and that the agreement of parents to participate is on an entirely voluntary basis and they will be informed of their right to withdraw from the study at any point.

We understand that participant information will be provided to parents to ensure they are fully informed of all the study details and have the opportunity to ask questions prior to agreeing to be involved. A consent form will be agreed and signed prior to the start of any interviews. Following agreement to participate all information collected from parents during the interviews will be anonymous so that individuals are non-identifiable.

We understand that agreeing to take part as a study site will involve the researcher; Faye Bentley visiting the centre, at an agreed time/s to explain the research to staff and parents as necessary. We will support the recruitment of participants through the use of existing communication channels including, the display of posters with study information, staff support to hand out information packs to parents who declare an interest, information on the website and within newsletters. We also agree that the researcher may use the existing baby and toddler groups to talk to parents about the

study and invite them to take part. We understand that full ethics clearance from Anglia Ruskin University and Cambridge County Council Research Governance will be granted prior to the start of any recruitment of parent volunteers.

I confirm that I agree for the _____ [redacted] children's centre to be a study site for this PhD research

_____

Signature

_____

Name and Job Title *(Please print)*

Appendix B – Poster for Children's Centre

Anglia Ruskin University
Cambridge & Chelmsford

Research Volunteers Required.

Parent views on the future risks of infants becoming overweight

You are invited to get involved in this research project being run at your Children's Centre.

The research is part of my PhD study at Anglia Ruskin University in Cambridge.

WHAT IS THE STUDY ABOUT?
To hear and understand your views on babies and infants and the future risks of becoming overweight. We will at no point be weighing your baby we are just looking to hear your views around this topic. All your views will remain anonymous.

WHO SHOULD VOLUNTEER?
Any parents/guardians of a child under 1 year.

WHAT WILL I HAVE TO DO?
Have an informal individual discussion about your views with me either face to face or over the telephone at a time and venue convenient to you.

HOW LONG WILL IT TAKE?
The discussion will take no longer than 120mins (2hours) of your time.

WHAT DO I DO IF I AM INTERESTED?
If you would like more information please ask a Children's Centre staff member for a participant information sheet.

If you have any questions then please contact me directly on 07765852568 or email faye.bentley@student.anglia.ac.uk

Appendix C – Participant Information Sheet (Study One)

Anglia Ruskin University
Cambridge & Chelmsford

Assessing an infant's risk of becoming overweight: A parent's view

I would like to invite you to take part in my PhD research being run from Anglia Ruskin University in Cambridge. I would be grateful if you could take the time to read through this information and consider whether you would like to be involved.

About the Study

Recent studies have shown that there are certain factors that are linked to an increased chance of an infant becoming an overweight child. The purpose of the research is to talk to parents of young children such as yourself, to understand your views about the causes of excess weight of infants and children and what you think can be done to prevent this. I would also like to talk to you about your views about whether if an infant is at an increased risk of becoming overweight they should they be identified and parents told about this future risk.

What will the study involve if I agree to take part?

Those who volunteer should be happy to discuss their views about this topic with myself as the researcher. The discussion will take place at a convenient time and venue to you. The interviews will take place face to face or over the telephone and should last for no more than 120 minutes (2 hours). I will also ask you for some information about yourself (your age, sex etc.) at the end of the discussion. Your answers will not be personally identifiable.

Why have I been invited to take part?

You are parent or guardian of an infant and you are therefore are well placed to be able to describe and discuss your views and thoughts on this topic.

What will the discussion be about?

I will ask a number of general questions to open up a discussion about your views. The conversation will be audiotaped so I can pay full attention to the process and do not have to write everything down.

What will the study team do with the information collected?

All information collected will be stored safely within a locked cabinet at the PhD students' research office at Anglia Ruskin University. Computer files will be kept on a secure drive and will be password protected and only accessed by the researcher and research team. Any personally identifiable information (such as names of people or places) will be removed. The information from our conversation will be summarised, and reported as part of my PhD thesis and may also be published within a scientific journal. Information will only be kept for the duration required to complete the PhD research project, no longer than 6 years in total. With your permission your details will be kept on the study database so you can be contacted to volunteer in future stages of this PhD research, these will be deleted after completion of the PhD, no longer than 6 years.

What might happen if I take part?

There is the chance that as commonly experienced by many parents you may already have some concerns about your child's feeding or growth. Involvement in the study should not lead to any further concerns as discussions are focused around your views on weight. We will not at any point be performing any intervention on or identifying children individually only exploring your views as parents.

Do I have to take part?

It is entirely up to you whether you would like to participate in the study. You will not be expected to take part just because you have been asked to. If you decide not to be involved, it will not affect your future interaction with the children's centre activities or staff in any way. If you do decide to participate, you are free to withdraw from the study at any time and any information collected so far will be destroyed.

What do I do now?

If you would like to be involved or find out more, email Faye Bentleyfaye.bentley@student.anglia.ac.uk or call 07765852568, alternatively you can tell a member of staff from the Children's Centre that you may interested in being involved and provide them with a number or email that I can contact you on. With your permission I will contact you by telephone to discuss your involvement. Before any interview take place or information is collected I will ask you to fill out a consent form (sample enclosed for your information). This is to get written agreement that you are willing to take part in the study.

Appendix D – Consent Form

Assessing an infant's risk of becoming overweight: A parent's view

Chief Researcher: Faye Bentley

Thank you for reading the enclosed information sheet for this study. Please contact me if there is anything that is not clear or if you would like more information.

Please answer the following questions by PLACING YOUR INITIALS IN THE BOX next to the appropriate response.

☐ NO, I do NOT wish to take part in the study.

☐ YES, I would like to take part in the study.

If you decide to take part, please initial each box as appropriate:	Please Initial
1. I confirm that I have read and understood the information sheet dated March 2014 for the above study and have had the opportunity to ask questions.	☐
2. I understand that my involvement is voluntary and that I am free to withdraw at any time, without giving any reason.	☐
3. I understand that the discussion will be audio taped and will be used as part of PhD thesis and may be published with a scientific journal. All information collected will be anonymous.	☐
4. I agree that my personal contact details can be kept on the study database so that I can be contacted to volunteer in future stages of this PhD research, details will be deleted after completion of the PhD, no longer than 6 years.	☐

5. I agree to keep the proceedings of the discussion confidential. ☐

6. I agree to participate in the above study. ☐

_____	_____	_____
Please sign above	Name of Participant *(Please print)*	Date

_____	_____	_____
Researcher Signature	Name *(Please print)*	Date

Thank you very much for taking the time to consider the study and fill in this consent form.

Completing this form now does not commit you to taking part later if you do not wish to do so.

Withdrawal Slip

If at any point you wish to withdraw from the study please complete the slip below and return to Faye Bentley; PhD Student. Public Health Directorate, Anglia Ruskin University, Cambridge Campus, East Road, Cambridge, CB1 1PT .
Faye.bentley@student.anglia.ac.uk

☐ I **NO** longer wish to/Am no longer able to take part in the study.

_____	_____	_____
Please sign above	Name of Participant *(Please print)*	Date

Appendix E – Ethics Approval (Study One)

Anglia Ruskin University

Cambridge Chelmsford Peterborough

Ref: SR/PK/PPH/DREP/14-002

Enquiries: DREP-PPH@anglia.ac.uk
Direct Line: 0845-196-2546
Date: 19th March 2014

Chelmsford Campus
Bishop Hall Lane
Chelmsford
CM1 1SQ

T: 0845 271 3333
Int: +44 (0)1245 493131
www.anglia.ac.uk

Dear Faye,

Re: Application for Ethical Approval

Project Number:	PPH/DREP/14-002
Project Title:	Identifying infants at risk of becoming overweight: a Parent Perspective
Principal Investigator:	Faye Bentley

Thank you for your application for ethical approval which was considered by the Faculty (of Health, Social Care & Education) Departmental Research Ethics Panel (DREP) for Primary & Public Health Department week commencing 10th March 2014.

I am pleased to inform you that your research proposal has been approved by the Faculty Research Ethics Panel under the terms of Anglia Ruskin University's *Policy and Code of Practice for the Conduct of Research with Human Participants*. Approval is for a period of three years from 19th March 2014.

It is your responsibility to ensure that you comply with Anglia Ruskin University's Policy and Code of Practice for Research with Human Participants and specifically:

- The procedure for submitting substantial amendments to the committee, should there be any changes to your research. You cannot implement these changes until you have received approval from FREP for them.
- The procedure for reporting adverse events and incidents.
- The Data Protection Act (1998) and any other legislation relevant to your research. You must also ensure that you are aware of any emerging legislation relating to your research and make any changes to your study (which you will need to obtain ethical approval for) to comply with this.
- Obtaining any further ethical approval required from the organisation or country (if not carrying out research in the UK) where you will be carrying the research out. Please ensure that you send the FREP Secretary copies of this documentation.
- Any laws of the country where you are carrying the research out (if these conflict with any aspects of the ethical approval given, please notify FREP prior to starting the research).
- Any professional codes of conduct relating to research or research or requirements from your funding body (please note that for externally funded research, a project risk assessment must have been carried out prior to starting the research).

- Notifying the FREP Secretary when your study has ended.

Information about the above can be obtained on our website at:

http://web.anglia.ac.uk/anet/rdcs/ethics/index.phtml/

http://web.anglia.ac.uk/anet/faculties/hsce/research-ethics.phtml

Please also note that your research may be subject to random monitoring by the Committee.

Please be advised that, if your research has not been completed within three years, you will need to apply to our Faculty Research Ethics Panel for an extension of ethics approval prior to the date your approval expires. The procedure for this can also be found on the above website.

Should you have any queries, please do not hesitate to contact me. May I wish you the best of luck with your research.

Yours sincerely,

Dr Sarah Redsell (Chair)
For the Faculty (of Health, Social Care & Education) Departmental Research Ethics Panel

T: 0845 196 2421
E: sarah.redsell@anglia.ac.uk

cc: Jennifer Lim (Sponsor)
Beverley Pascoe (RESC Secretary)

Appendix F – Search Terms

Parent/Maternal perception of health and other related risks of infant overweight

(consequences of childhood obesity) OR (risks of childhood obesity)) AND (parent* awareness or parent* knowledge)
Obesity risk knowledge AND childhood obesity OR Childhood overweight
Health risk knowledge childhood obesity OR Childhood overweight
Health risk knowledge AND obesity
(consequences or effects or outcomes) AND (childhood obesity or childhood overweight) AND (parent perceptions or parent attitudes)
(weight related health risk) AND (parent* perception OR maternal perception)
weight related health risk AND parental perception
(weight related health risk) AND (measure or scale or inventory or assessment or questionnaire or instrument)
(risk perception or perception of risk or perception of risk factors or perception of health risk) AND (childhood obesity or children overweight or obese child) AND (measure or scale or inventory or assessment or questionnaire or instrument)
(risk perception or perception of risk or perception of risk factors or perception of health risk) AND (childhood obesity or children overweight or obese child)

Parental/maternal guilt and/or shame in relation to childhood overweight

((maternal guilt and shame) OR (mother* guilt and shame) OR (parent* guilt and shame)) AND (child* obesity OR child* overweight OR infant weight)
((maternal shame) OR (mother* shame) OR (parent* shame)) AND (child* obesity OR child* overweight OR infant weight)
((maternal guilt) OR (mother* guilt) OR (parent* guilt)) AND (child* obesity OR child* overweight OR infant weight)
((maternal guilt) or (mother* guilt) or parent* guilt AND childhood obesity
((maternal guilt) or (mother* guilt) AND childhood obesity
((maternal guilt) or (mother* guilt) AND obesity
(measure or scale or inventory or assessment or questionnaire or instrument) AND ((Parent* guilt or parental shame)) AND obesity

Maternal/Paternal self-blame in relation to child overweight /weight

(measure or scale or inventory or assessment or questionnaire or instrument) AND parental self-blame AND (obesity or overweight)
(measure or scale or inventory or assessment or questionnaire or instrument) AND parental self-blame AND (obesity or overweight)
(measure or scale or inventory or assessment or questionnaire or instrument) AND parental self-blame attributions
(maternal (self blame) or (self-blame) AND obesity
(measure or scale or inventory or assessment or questionnaire or instrument) AND parental self-blame
(measure or scale or inventory or assessment or questionnaire or instrument) AND self-blame attributions
(measure or scale or inventory or assessment or questionnaire or instrument) AND ((self blame) or (self-blame)) AND obesity

Maternal fear of negative evaluation or judgment about their infant's weight

fear of judgement AND childhood obesity
maternal judgement AND (obesity or overweight)
maternal judgement AND (obesity or overweight)
parental judgement AND (obesity or overweight)
fear of judgement AND (obesity or overweight)
fear of judgement AND (child obesity or overweight)
fear of negative evaluation AND (child obesity or overweight)
fear of negative evaluation AND (obesity or overweight)

Parental perceptions of the causes/causal attributions of childhood overweight

(cause* or causal attributions) AND (childhood overweight or childhood obesity) AND (perception* or attitude* or opinion) AND (measure or scale or inventory or assessment or questionnaire or instrument)
(causes or causal attributions) AND (overweight and obesity) AND (perceptions or attitudes or opinion) AND (measure or scale or inventory or assessment or questionnaire or instrument)
causes AND (childhood overweight and obesity) AND (perceptions or attitudes or opinion) AND (measure or scale or inventory or assessment or questionnaire or instrument)
causes AND (childhood overweight and obesity) AND (perceptions or attitudes or opinion)

causal attributions AND (childhood overweight or childhood obesity)
(perceptions or attitudes or opinion) AND causal attribution AND (childhood overweight and obesity)
(maternal perception OR parental perception OR mothers views) AND causal attribution AND (childhood overweight and obesity)
(maternal perception OR parental perception OR mothers views) AND the cause* of childhood obesity
(maternal perception OR parental perception OR mothers views) AND (cause* of childhood obesity OR cause* of childhood overweight)
'views on the causes of childhood obesity'

Parental Self-Efficacy (PSE) to influence child health behaviour

(measure or scale or inventory or assessment or questionnaire or instrument) AND ((parent* self-efficacy or maternal self-efficacy)) AND infant weight gain
(measure or scale or inventory or assessment or questionnaire or instrument) AND ((parent* self-efficacy or maternal self-efficacy)) AND (obesity prevention in children) OR (prevention of childhood obesity)
(measure or scale or inventory or assessment or questionnaire or instrument) AND ((parent* self-efficacy or maternal self-efficacy)) AND infant feeding practices
(measure or scale or inventory or assessment or questionnaire or instrument) AND ((parent* self-efficacy or maternal self-efficacy)) AND infant feeding (HAD to also relate to obesity prev to be included)
(measure or scale or inventory or assessment or questionnaire or instrument) AND ((parent* self-efficacy or maternal self-efficacy)) AND infant weight
(measure or scale or inventory or assessment or questionnaire or instrument) AND ((parent* self-efficacy or maternal self-efficacy)) AND health behaviour OR health behavior

Maternal perception of responsibility for the prevention of childhood obesity

parental responsibility AND child* obesity OR child* overweight AND (measure or scale or inventory or assessment or questionnaire or instrument)
parental responsibility AND obesity prevention
parental responsibility AND (childhood overweight and obesity)
(maternal responsibility or parental responsibility) AND (childhood overweight OR childhood obesity)
(maternal responsibility or parental responsibility)) AND (childhood overweight OR childhood obesity) AND prevention
(responsibility or responsibility attributions) AND (overweight and obesity) AND (perceptions or attitudes or opinion) AND (measure or scale or inventory or assessment or questionnaire or instrument)

(responsibility or responsibility attributions) AND (overweight and obesity prevention) AND (perceptions or attitudes or opinion) AND (measure or scale or inventory or assessment or questionnaire or instrument)
Measure or scale AND attributions of responsibility AND obesity

Appendix G – Content Validity Email and Instructions

Email content;

Dear X

My name is Faye Bentley, a PhD student at Anglia Ruskin University researching the identification of the future risk of childhood obesity and I am looking to recruit some clinical experts to help with phase two of my research. Agreement to help would involve looking over some questions that will form part of a questionnaire and providing some feedback via email, I anticipate this should take no longer than 20 minutes.

The overall purpose of my research is to examine the potential benefits, harms, and acceptability of the assessment and communication of future obesity risk during infancy from a parent's point of view. I attach some details about the findings of the first phase of the study that involved qualitative interviews with 19 parents from Cambridgeshire Children's Centres. From these findings the aim is to develop and pilot a scale (The Parental Engagement in Obesity Prevention Scale (PEOPS)) to assess the barriers and facilitators to talking to parents of infants about the future risk of childhood obesity and early prevention.

I would be grateful if you could help me by checking if the questions in the attached document are the right things to ask parents about obesity prevention. If you would be interested in helping please read the attached document and let me know your views. All responses will be anonymous in the write up of the final study. Please do not hesitate to contact me should you require any further information.

Best Wishes

Instructions and questions;

Thank you for agreeing to help with my study. The main purpose of your feedback is to help assess how useful the questions in my survey are for measuring and gathering information about childhood obesity from mothers of infants. It is important that the questions both individually and as a set are relevant to what is being measured. The questionnaire is designed to measure six main constructs:

1. Mother's confidence to prevent overfeeding
2. Mother's confidence to identify overweight in infancy
3. Mother's perception of infant weight and health risks of infant overweight
4. Mother's perceptions of the causes of overweight in infants
5. Mother's guilt and self-blame in relation to infant overweight
6. Mother's fear of being negatively judged about their infants weight

You may notice that there are quite a large number of questions and that some may seem very similar, this is because this is the first version of the survey and it is necessary to start with more questions than will appear within the final questionnaire . Please ignore questions that sound like they are asking the same thing, this is intentional. The questions will be posted on a public internet site so will be answered electronically and placed in a slightly different order, so please don't worry about the order. Participants will be asked to indicate their level of agreement from the following seven options; strongly agree, moderately agree, agree, neither agree or disagree, disagree, moderately disagree, strongly disagree.

Please look at the questions that fall under each of these headings and think about the following points

- Are there any obvious questions you think are missing?
- Do the questions relate to what they are supposed to be measuring e.g. mother's perception of the causes of overweight?
- Is the language used appropriate and understandable to mothers?
- Are the questions understandable; are there any that mothers maybe confused by?
- Is any of the questions bias, i.e. do you think they would lead the mother to respond in a positive or negative way?

Measure 1 – Mother's Confidence to preventing overfeeding

1. I am confident that I can feed my baby so they do not gain too much weight
2. I am confident that I can feed my baby so they gain enough weight
3. I am unsure whether I can feed my baby the right amount to prevent them gaining too much weight*.
4. I am unsure that I can feed my baby sufficiently to ensure that they are not underweight*
5. I find it impossible to tell whether my baby is drinking too much milk
6. I am certain that I can stop my baby drinking too much milk.
7. I am unsure whether I can stop my baby drinking too much milk*
8. I do not feel able to resist my baby's demands for milk even if I know they are not hungry*
9. When my baby is crying, I can distract them without using extra milk or food.
10. I am confident that I could stop my baby over-eating once they were on a solid diet and not milk alone.
11. I would feel confident about giving my baby less milk if I thought they were becoming overweight
12. I would not feel confident about reducing my baby's milk
13. I can tell from my baby's cry whether or not they are hungry or not
14. I sometimes feed my baby to comfort them or help them sleep even if I know they may not need feeding
15. I would find it difficult to tell if my baby was over-eating solid food*
16. I am confident that I can settle my baby without giving them extra milk or food.
17. I am certain that I can have a happy, content baby without giving them extra milk or food*.

18. I do not feel confident that I am able to ensure my baby maintains a healthy weight

Measure 2 – Mother's confidence to identify overweight in infancy

1. I am confident that I would be able to judge if my baby was bigger than other babies of the same age
2. I am confident that I would be able to judge if my baby was bigger than their brother/sister was at the same age.
3. I am confident that I would be able to judge if my baby was overweight or obese*
4. I am unsure if I would be able to tell if my baby was overweight
5. I am unsure if I would be able to tell if my baby was obese
6. I am confident I would recognise if my baby's weight were affecting development of their movement skills i.e. starting to stand or walk.
7. I am not sure if I would recognise if my baby's weight was affecting development of their movement skills i.e. starting to stand or walk*
8. Regardless of what a healthcare professional might say, I am sure that I would be able tell if my baby was overweight.
9. Regardless of where my baby's weight is on the growth chart in the 'red book' I am positive that I would be able to tell if they were overweight.
10. The only way that I can be certain that my baby has not or does not gain too much weight, is to see where their weight is plotted on the growth chart in the 'red book'*
11. It is not possible to tell if my baby is overweight until they start to walk.
12. My baby's weight is exactly what it should be for their age

Measure 3 - Mother's perception of infant overweight and weight-related health risk

1. Many children already weigh too much before they are two years old
2. Many children already weigh too much before they start school
3. Overweight babies are more likely to develop health problems than healthy weight babies
4. In babies, there are no health risks associated with being overweight*
5. Overweight babies are more likely to become overweight children
6. It is unlikely that an overweight baby will become overweight when they are an older child*
7. Overweight babies are more likely to become overweight adults
8. The health risks of being overweight do not become serious until a child starts walking
9. The health risks of being overweight do not become serious until a child reaches school age
10. The health risks of being overweight are not serious unless the baby is very, very big or obese
11. It is more healthy for a baby to be overweight than underweight
12. It is more of a risk to a baby's health to be underweight than overweight*
13. A happy and content baby indicates a healthy baby.
14. Being overweight or obese makes it difficult for babies to start walking
15. Being overweight or obese negatively affects a baby's ability to learn and meet their developmental milestones

Measure 4 – Mother's perceptions of the causes of infant overweight

1. Babies become overweight when they don't move around enough
2. Babies become overweight because they drink too much breast milk.
3. It is not possible for breastfed babies to become overweight*
4. Babies become overweight because they are overfed bottled or formula milk

5. It is not possible for a formula fed baby to become overweight from too much formula milk*
6. It is not possible for a baby to become overweight when they are on a milk only diet.
7. A baby is more likely to become overweight if its biological mother is overweight.
8. A baby is more likely to become overweight if its biological father is overweight.
9. Some babies become overweight because they are hungrier than other babies.
10. Some babies become overweight because they have slower metabolisms than other babies.
11. Some babies become overweight due to a medical condition
12. Baby boys are more likely than baby girls to become overweight
13. Baby boys are less likely to become overweight than baby girls*
14. A baby's weight is not influenced by its parents' weight*
15. A baby's weight is not determined by its genes*.
16. Overweight babies are not just born that way*.
17. If a baby becomes overweight there is not much that can be done until they start to walk.
18. A baby's weight can only be controlled when it is eating solid food
19. There is nothing that parents can do to prevent their baby becoming overweight

Measure 5: Mother's guilt and self-blame in relation to infant weight

1. I feel guilty about using formula rather than breast milk to feed my baby
2. I feel guilty about not being able to breastfeed my baby
3. I feel guilty about not trying to breastfeed my baby
4. I was made to feel guilty by others about not breastfeeding my baby
5. I don't feel guilty about choosing not to breastfeed my baby*
6. I don't feel guilty about not being able to breastfeed my baby*
7. I feel guilty that I feed my baby whenever they cry
8. I don't think mothers who choose not to breastfeed their baby should feel guilty
9. I would feel guilty if I didn't give my baby milk if they were crying
10. I would feel guilty if I refused my baby solid foods if they were crying for more
11. I feel guilty when I give my baby jarred or readymade foods
12. I would feel guilty if I gave my baby less formula milk than the tin said I should.
13. I often feel guilty about the way I feed my baby
14. I feel guilty about my baby's weight
15. I would blame myself if my baby was overweight
16. I would not blame myself if my baby was overweight*

Measure 6: Mother's fear of being negatively judged about their infants weight evaluation

1. I feel comfortable with the way my baby looks
2. I am comfortable with what other people think of my baby's weight
3. I get tense when it is obvious that people are looking at my baby
4. I am concerned that people will judge me because of my baby's weight
5. It doesn't worry me what others think about my baby's weight
6. I worry that other mothers talk about my baby's weight when I am not around
7. I am concerned what the health professionals will say about my baby's weight when I get them weighed in clinic
8. I am concerned that people will think I am a bad mother because of my baby's weight
9. It is acceptable for children to look overweight when they are babies it is when they get older it is more of a problem

Appendix H – Participant Information (Study Two)

Parent Volunteers Required – Are you a mother of a child aged 1 year or under living in the UK? If so, please would you consider helping with my PhD research by completing a short, anonymous online survey?

Recent studies have shown that there are certain factors that are linked to an increased chance of a baby or infant becoming an overweight child. The purpose of my research is to gain mothers views about weight gain during infancy, and to understand the ways in which health professionals can best talk to mothers about the future risk of obesity. Agreement to take part would involve completing an online survey of questions about infant weight and feeding, and your experiences and opinions as a mother. The survey takes approximately 15 minutes to complete and all information is anonymous.

The questions will inform the development of full questionnaire for use in future research, information collected will be used for the purposes of my PhD thesis. If you have any queries or further questions about the study, please email Faye Bentley faye.bentley@student.anglia.ac.uk

Please click here to access the survey….

Title: Infant weight and feeding – Your views are needed.

Are you a mother of a child aged 1 year or under living in the UK? If so, please would you consider helping with my PhD research by completing a short, anonymous online survey?

The purpose of my research is to gain mothers views about childhood growth and weight and to understand the ways in which health professionals can best talk to mothers about overweight. Taking part involves completing an anonymous online survey which asks for your views and experiences about your baby's weight and feeding. The survey takes approximately 15-20 minutes to complete.

Information collected will be used for the purposes of my PhD all responses will be treated in the strictest of confidence and you will not be asked for your name at any point so all responses are anonymous. If you are interested in taking part then please click on the link below

https://aruspsych.eu.qualtrics.com/SE/?SID=SV_9pBGfZ08j32kwkJ

If you have any queries or further questions you would like to ask prior to agreeing to take part then, please me at Faye Bentley faye.bentley@student.anglia.ac.uk . This has been posted with permission of LyndaBC.

Appendix I – Ethics Approval (Study Two)

18th February 2016

Dear Faye

Principal Investigator	Faye Bentley
DREP Number	SNM/DREP/15/007
Project Title	Identifying infants at risk of becoming overweight: A parent perspective.

As you have now addressed the ethical issues, I am pleased to inform you that your ethics application has been approved by the Faculty Research Ethics Panel (FREP) under the terms of Anglia Ruskin University's Research Ethics Policy (Dated 23/6/14, Version 1).

Ethical approval is given for a period of 3 years from 18th February 2016.

It is your responsibility to ensure that you comply with Anglia Ruskin University's Research Ethics Policy and the Code of Practice for Applying for Ethical Approval at Anglia Ruskin University, including the following.

- The procedure for submitting substantial amendments to the committee, should there be any changes to your research. You cannot implement these amendments until you have received approval from DREP for them.
- The procedure for reporting adverse events and incidents.
- The Data Protection Act (1998) and any other legislation relevant to your research. You must also ensure that you are aware of any emerging legislation relating to your research and make any changes to your study (which you will need to obtain ethical approval for) to comply with this.
- Obtaining any further ethical approval required from the organisation or country (if not carrying out research in the UK) where you will be carrying the research out. Please ensure that you send the DREP copies of this documentation if required, prior to starting your research.
- Any laws of the country where you are carrying the research and obtaining any other approvals or permissions that are required.
- Any professional codes of conduct relating to research or requirements from your funding body (please note that for externally funded research, a Project Risk Assessment must have been carried out prior to starting the research).

- Completing a Risk Assessment (Health and Safety) if required and updating this annually or if any aspects of your study change which affect this.
- Notifying the DREP Secretary when your study has ended.

Please also note that your research may be subject to random monitoring.

Should you have any queries, please do not hesitate to contact me. May I wish you the best of luck with your research.

Yours sincerely,

Emmanuel Idowu

Dr Emmanuel Idowu (Chair)
For the Nursing & Midwifery Department Research Ethics Panel (DREP)

T: 0845 196 4759
E: emmanuel.idowu@anglia.ac.uk

cc: Dave Hawkes/Sharon Andrew (DREP Reviewers)
Beverley Pascoe (RESC Secretary)

Appendix J – Ethics Approval extension (Study Two)

Anglia Ruskin University

22nd September 2017

Cambridge & Chelmsford

Chelmsford Campus
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Chelmsford Essex CM1 1SQ

Tel: 01245-493131
Int: +44 (0)1245-493131

Faye Bentley

Dear Faye,

Project Number:	**SNM/DREP/15/007**

Project Title:	**Identifying infants at risk of becoming overweight: a Parent Perspective**
Principal Investigator:	**Faye Bentley**

Further to your letter to extend your completion date, I can confirm that the extension request has been approved with a new date of June 2018.

Yours sincerely,

Emmanuel Idowu

Emmanuel Idowu (Vice Chair)
For the FHSCE Department Research Ethics Panel (DREP)
T: 0845 196 4759
E: Emmanuel.idowu@anglia.ac.uk

Copy to: Sarah Redsell